For engineers who design and manage the power and plant services

Power

FEBRUARY 1960
ONE DOLLAR
A McGRAW-HILL PUBLICATION

How new insulations stretch motor life

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Factory-assembled panels for low-voltage switchboards

Designed to save space with a clear layout.
Metal clad for accident prevention.
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to suit your own needs.

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made up of factory-assembled panels
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Berlin (West) EXPORT DEPARTMENT Frankfurt (Main)

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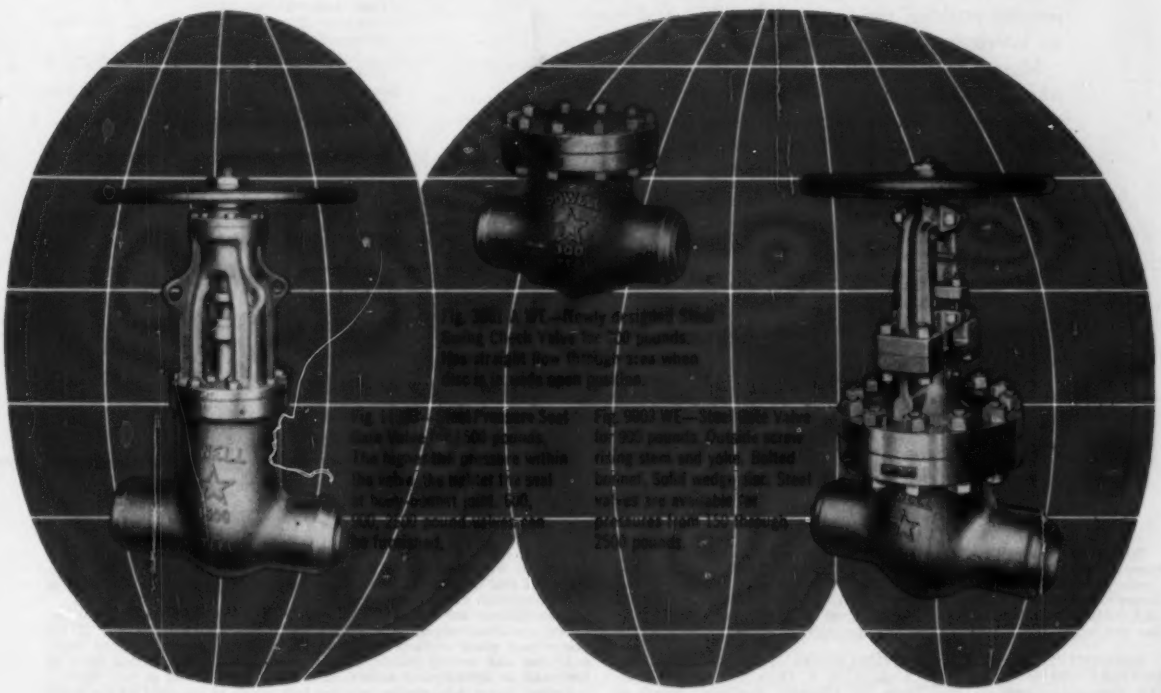

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speaking of **Power**

WOEHR AND ELONKA with unbent propeller for Marmy

More than 12 years have passed since Associate Editor Steve Elonka proposed that Marmaduke Surfaceblow become a monthly POWER feature. It was an off-beat idea but Editor Phil Swain bought it. Steve's formula for Marmy: lift a practical engineering problem right out of the plant and weave an interesting tale around its solution.

Marmy was created in the role of an engineer who had oiled and fired his way around the world in engine rooms on land and sea. Through the years the Marmy stories have been well received by a most critical audience—POWER readers.

Since the old consultant spends much time at the Bent Propeller Bar, International Nickel proposed a well-machined *unbent* corrosion-resistant screw propeller for the back bar. Inco's Andy Woehr presented Steve with the *Ni-Bral* model at their Technical Conference in Harbor Island, N. C.

Lou Rowley

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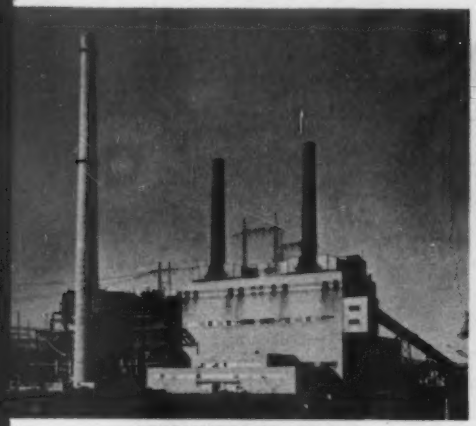
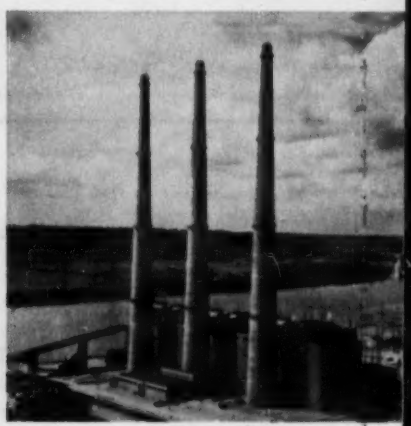


MUSKINGUM RIVER
9161 Btu/kwhr Ohio Power Co.
on the American Electric Power System
Two B&W Pressure-Fired Open-Pass Boilers and two Pressure-Fired Radiant Boilers

RIVER ROUGE
9160 Btu/kwhr
Detroit Edison Co.
One B&W Radiant Boiler
Firing 10% Blast Furnace Gas and 90% Coal

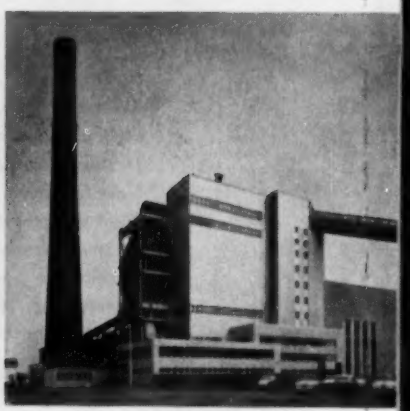


CLIFTY CREEK
9130 Btu/kwhr
Indiana-Kentucky Electric Corporation*
Six B&W Pressure-Fired Open-Pass Boilers

ALLEN
9178 Btu/kwhr
Duke Power Co.

McMEEKIN
9093 Btu/kwhr
Part year, more than 6 months
South Carolina Electric and Gas Co.

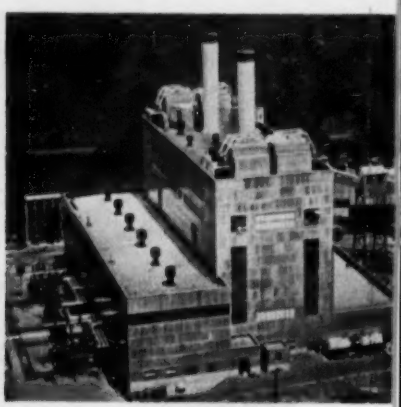
KANAWHA RIVER
9143 Btu/kwhr
Appalachian Power Co.
on the American Electric Power System
Two B&W Pressure-Fired Radiant Boilers



BAY SHORE
9233 Btu/kwhr
Toledo Edison Co.
One B&W Radiant Boiler

TANNERS CREEK
9209 Btu/kwhr
Indiana & Michigan Electric Co.
on the American Electric Power System
Three B&W Pressure-Fired Radiant Boilers

KYGER CREEK
9166 Btu/kwhr
Ohio Valley Electric Corporation*
Five B&W Pressure-Fired Open-Pass Boilers



SHAWVILLE
9163 Btu/kwhr
Pennsylvania Electric Co.
Two B&W Radiant Boilers

FOR FIFTH CONSECUTIVE YEAR

B&W's Engineering Leadership Proved in Nation's Most Efficient Power Plants

It's the same story, year after year; most of the stations reported "best heat rate stations" by the Federal Power Commission are equipped with B&W Steam Generators. In the past five years . . .

1958 — 8 out of 10 "most efficient"
1957 — 8 out of 10 "most efficient"
1956 — 9 out of 10 "most efficient"
1955 — 7 out of 10 "most efficient"
1954 — 7 out of 10 "most efficient"

The "why" of this leadership is a pace setting research and development program that has given the power industry such innovations as gas tempering, the Universal Pressure Boiler, pressure firing, the Cyclone Furnace, and the Cyclone Steam Separator that makes natural circulation practicable in the highest pressure subcritical boilers.

B&W works closely with the Electric Utility industry helping to meet, often anticipating, their needs. In this way electric utilities and their suppliers can continue to fulfill their vital role in American growth. The Babcock & Wilcox Company, Boiler Division, Barberton, Ohio.

B&W

THE BABCOCK & WILCOX COMPANY

BOILER DIVISION

G-959-C5

***Ohio Valley Electric Corporation and its subsidiary, Indiana-Kentucky Electric Corporation, sponsored by these companies:**

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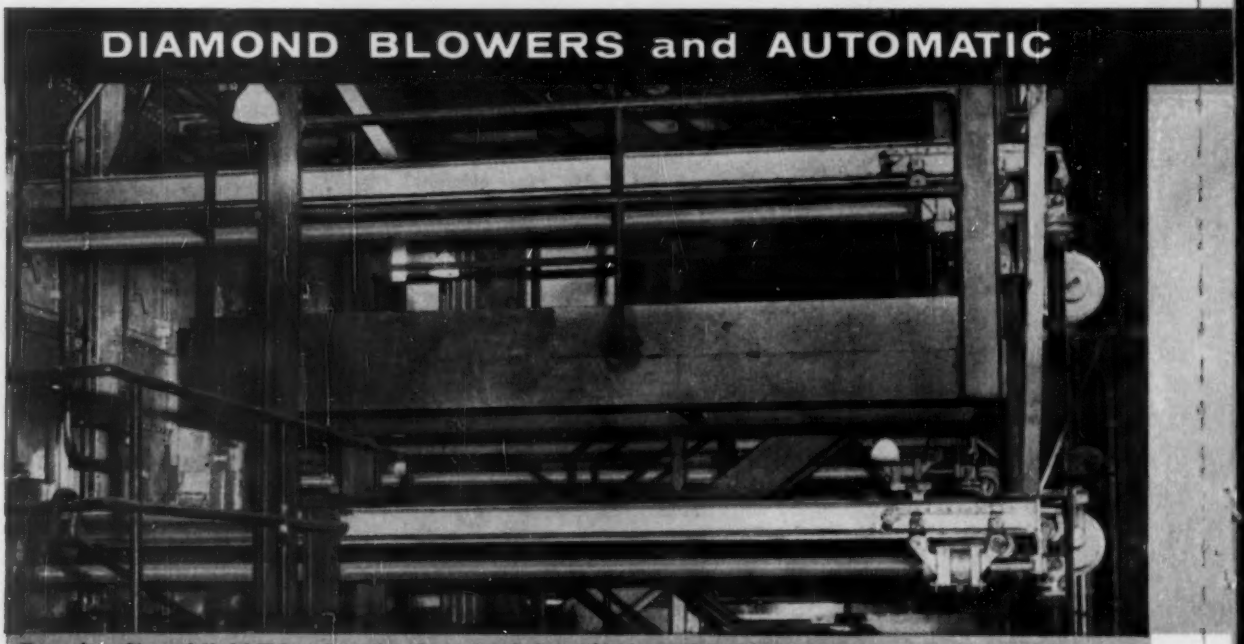
(a) Subsidiary of American Electric Power Co. (b) Subsidiary of The West Penn Electric Co. (c) Subsidiary of Ohio Edison Co.

AT F.M. TAIT STATION, DAYTON POWER & LIGHT CO.

BOILER CLEANING IMPROVEMENT HELPS MODERNIZATION PROGRAM

SAVE $40,000



Three of the Diamond Model IK Long Retracting Blowers installed to replace manually operated rotary blowers. Electric motor driven, they are controlled by the Automatic Sequential Panel. Air is used as the blowing medium. Rotary elements were retained in cooler locations and motorized for automatic operation and are also controlled by the Automatic Sequential Panel.

In the continuous struggle to cut operating costs, the Dayton Power & Light Co. has found a very useful tool in "Boiler Cleaning Modernization."

By applying the latest soot blowing equipment to four of their boilers at the F. M. Tait Station, together with other features of the modernization program, the Dayton Power & Light Co. was able to reduce the operating costs on these boilers by some $40,000 per year and also cut blower maintenance costs.

On the first boiler that had its cleaning modernized, 17 rotating elements were removed; the remaining seven blowers of this type were electrified for automatic control. The cleaning equipment added consisted of five Long Retracting Blowers and six Short Retracting Blowers. All blowers are automatically controlled by a Diamond Selectromatic Panel.

This is one of many examples of the savings possible by improvements now available in Diamond Blowers and Automatic Sequential Control. Over the years Diamond has engaged in continuous aggressive research in boiler cleaning. This research has paid off in improvements that save you money and improve your operation.

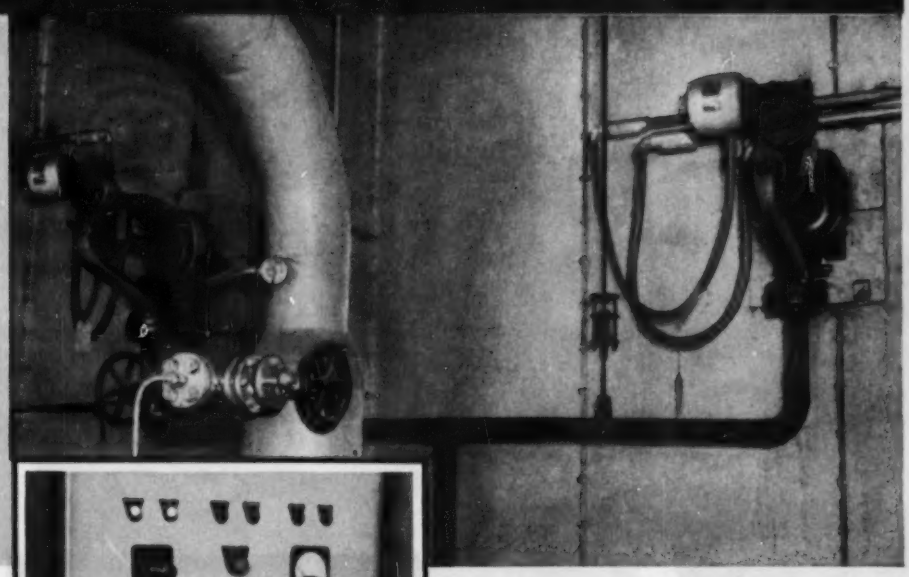
Let us make a study of your boiler cleaning . . . perhaps similar savings can be suggested.

◀ Circle 205 on Reader Service Card for Preceding Ad

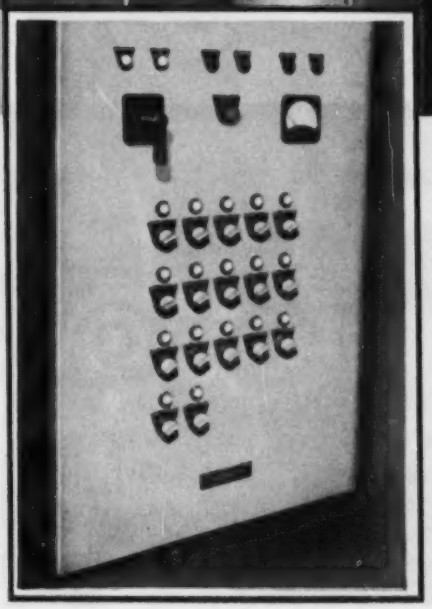
Per Year in Operation

and Cut Blower Maintenance Costs

SEQUENTIAL CONTROL PANEL



Two of the air blowing Model IR short retracting wall blowers with electric automatic operation.



Diamond Automatic Sequential Control Panel installed as part of the modernization program at the F. M. Tait Station. This panel automatically operates each blower in turn until the blowing cycle is complete. Any individual blower may be operated independently by simple turning switches. Cleaning program is set up by switches. Operator starts — thenceforth operation is automatic.

DIAMOND POWER SPECIALTY CORP.

LANCASTER, OHIO

8243

DIAMOND SPECIALTY LIMITED • WINDSOR, ONTARIO

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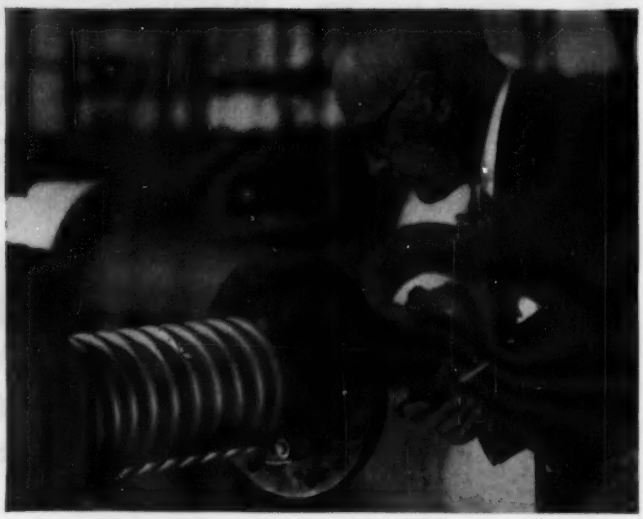
NEW...FROM



TUBE-TURN *Bellows Expansion Joints are test rated on basis of minimum cyclic life.*

TUBE TURNS...

Bellows Expansion Joints test rated for assured cyclic life

Tube Turns has introduced a brand new concept in bellows expansion joints to fill a vital need in engineered piping systems.

These new bellows joints are rated on the basis of thorough, well organized test studies to *assure a definite minimum cyclic life*..., rather than the usual average or maximum. This conservative rating, backed by Tube Turns' extensive test results, gives you an assurance of *confidence* heretofore lacking in the application of bellows joints.

Hence, you can specify TUBE-TURN* Bellows Expansion Joints and be sure of predictable performance. These top-quality products will be subject to the same warranties that apply to all other products of Tube Turns.

Backed by Tube Turns' technical service! This new line of products is backed by 31 years of pioneering research in piping technology, including problems of piping flexibility. Our sales-engineering staff, located nearby, will assist in the application of TUBE-TURN Bellows Expansion Joints to your specific problems.

Available from your nearby Tube Turns' Distributor. You can order TUBE-TURN Bellows Expansion Joints along with fittings and flanges from your complete-line Tube Turns' Distributor. Here is still another *plus value* you get when you specify and buy TUBE-TURN products.

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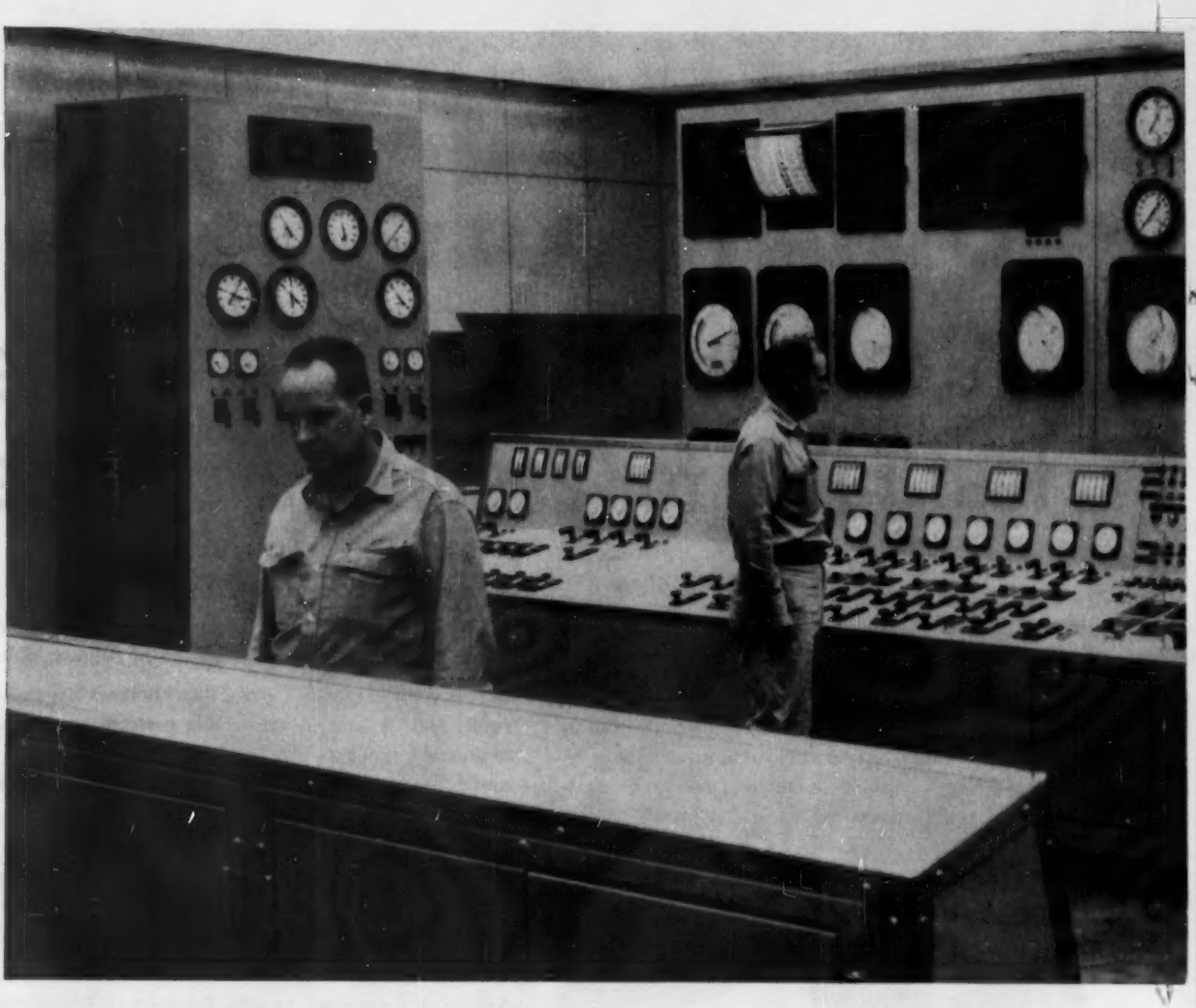


13 of 15 "most efficient"* power plants

Year after year you'll find Bailey Meters and Controls keeping sensitive fingers on the pulse of America's *most efficient* power plants (as rated by the Federal Power Commission).

According to the latest box scores, 10 of the top 15 used Bailey equipment exclusively. There must be a reason. There is. In fact, several:

1. Experience

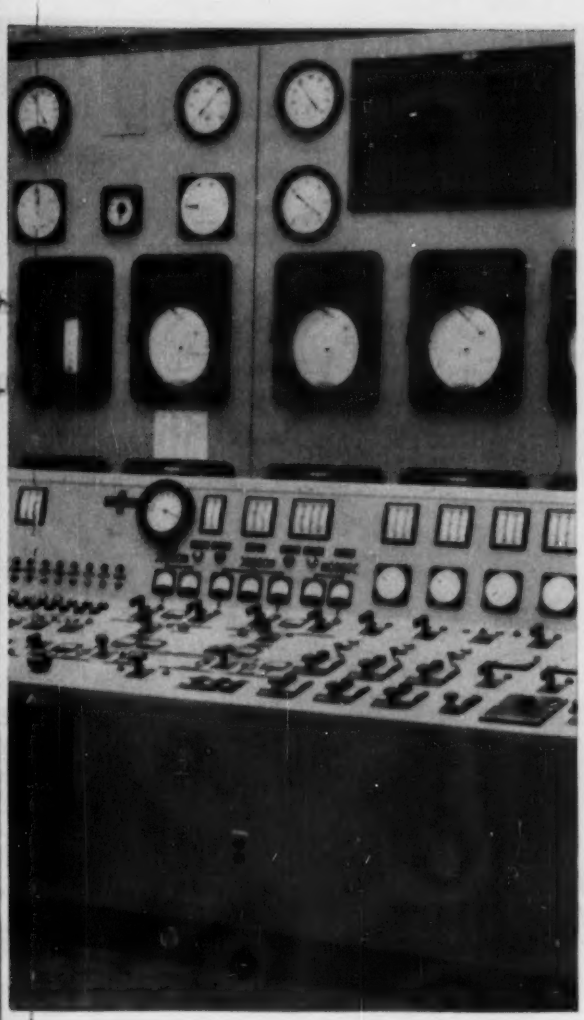
Bailey Engineers have been making steam plants operate efficiently for more than forty years. Veteran engineers and new engineers (the men who represent Bailey) are storehouses of knowledge on measurement and control. They bring you the latest, up-to-the-minute developments that can be applied to your problem.

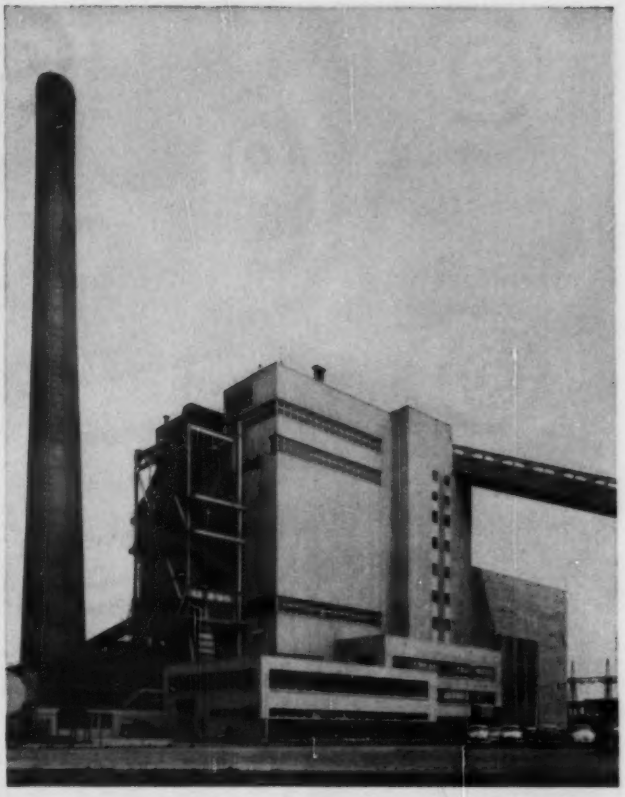
2. Complete Line of Equipment

Bailey manufactures a complete line of standard, compatible pneumatic and electric metering and control equipment that has proved itself. Thousands of successful installations, involving problems in measurement, combustion and automatic control, are your assurance of the best possible system. You can be sure a Bailey Engineer will offer you the right combination of equipment.

3. Sales and Service Convenient to You

There's a Bailey District Office or Resident Engineer close to you (listed under Bailey Meter Co. in your phone book). Phone for expert engineering counsel.





Bailey Controls for combustion, feed water and steam temperature at the Bay Shore Station of The Toledo Edison Company. The FPC reported a 1957 heat rate at Bay Shore of 9,210 Btu per kwhr, making it one of the 15 most efficient plants in the United States.

depend on Bailey Meters and Controls

✻ 15 MOST EFFICIENT PLANTS 1957 Heat Rates Reported by the Federal Power Commission

	Btu/kwhr	Meters	Comb. Control	Feed Water Control	Supht. Control
1. Kanawha River (Appalachian Electric Power Co.)	9,118	B	B	B	B
2. Muskingum River (The Ohio Power Co.)	9,139	B	B	B	B
3. River Rouge (The Detroit Edison Co.)	9,140	—	—	—	—
4. Clifty Creek (Indiana-Kentucky Electric Co.)	9,147	B	B	B	B
5. Tanners Creek (Indiana and Michigan Electric Co.)	9,180	B	B	B	B
6. Kyger Creek (The Ohio Valley Electric Corp.)	9,201	B	—	B	B
7. St. Clair (The Detroit Edison Co.)	9,210	B	B	B	B
8. Bay Shore (The Toledo Edison Co.)	9,210	B	B	B	B
9. G. G. Allen (Duke Power Co.)	9,349	B	B	B	B
10. John Sevier (Tennessee Valley Authority)	9,350	—	—	—	—
11. Phillip Sporn (Central Operating Co.)	9,370	B	B	B	B
12. Milliken (New York State Electric and Gas Co.)	9,371	B	—	B	—
13. Shawville (Pennsylvania Electric Co.)	9,396	B	—	—	B
14. El Segundo (Southern California Edison Co.)	9,467	B	B	B	B
15. Colbert (Tennessee Valley Authority)	9,490	B	B	B	B

A141-2

Instruments and controls for power and process

BAILEY METER COMPANY

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In Canada—Bailey Meter Company Limited, Montreal

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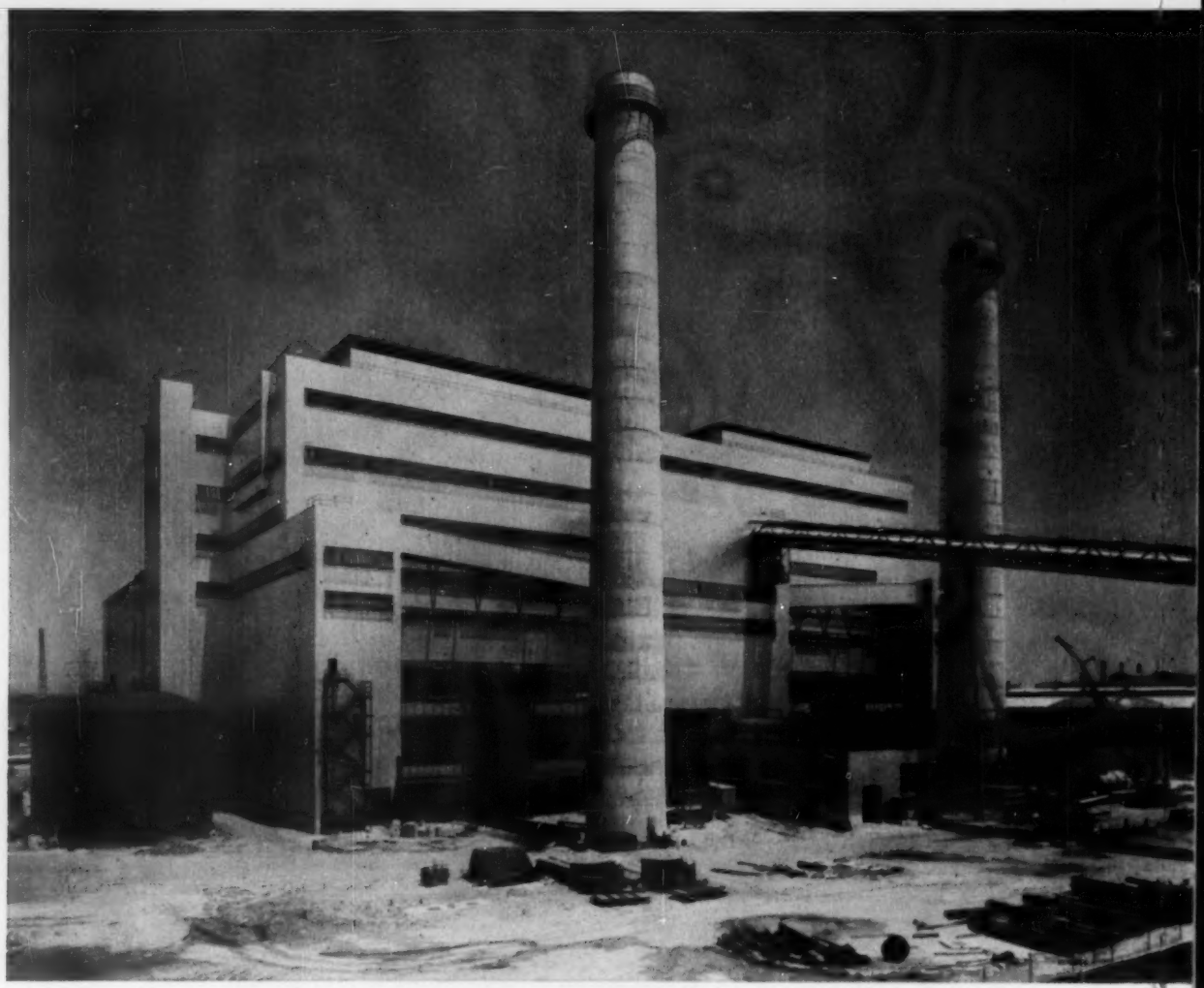


Eddystone Station's Unit 1 has a capacity of 2,000,000 lb/hr at 5000 psig, and 1200°/1050°/1050°/F . . . uses C-E Sulzer Monotube Steam Generator.

Vulcan Selective-Sequence system provides Eddystone Station with precision soot blowing

When Unit 1 of Philadelphia Electric's Eddystone Station went into operation, a Vulcan Selective-Sequence system was accurately controlling all soot blowing.

Selective-Sequence systems were chosen for both units 1 and 2 at this super-critical station because they assure positive, dependable boiler cleaning . . . make the most efficient use of the blowing medium.

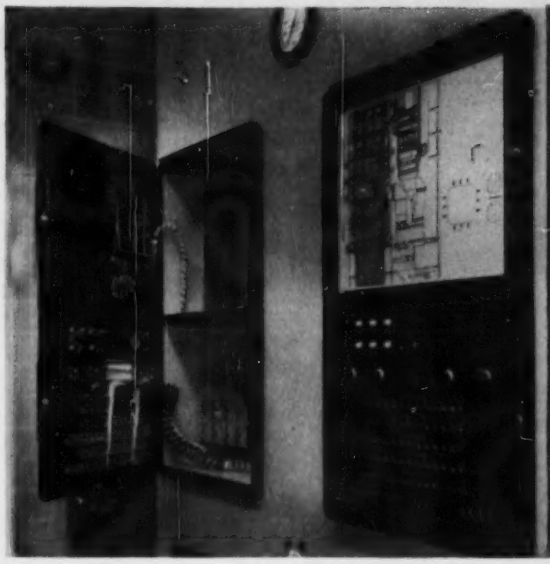
Vulcan Controller saves time. Without leaving the panel, the operator pushes a master button to place the system in sequential operation. He can see that each soot blower is operating in sequence for the proper interval with adequate pressure. He can modify the sequence to improve cleaning or conserve the blowing medium without time-consuming wiring and piping changes.

Vulcan long retractables speed cleaning. With dual-motor drive, Eddystone's T-30's minimize the danger of tube cutting or erosion. Low rotating speed increases range and penetration, decreases wear, eliminates whip, and permits cleaning with faster traversing speeds.

Half-'tracts with 19-foot travel, wall deslaggers, and air pre-heater controls are also used. For details, write Copes-Vulcan Division, Erie 4, Pa.

Copes-Vulcan Division

BLAW-KNOX

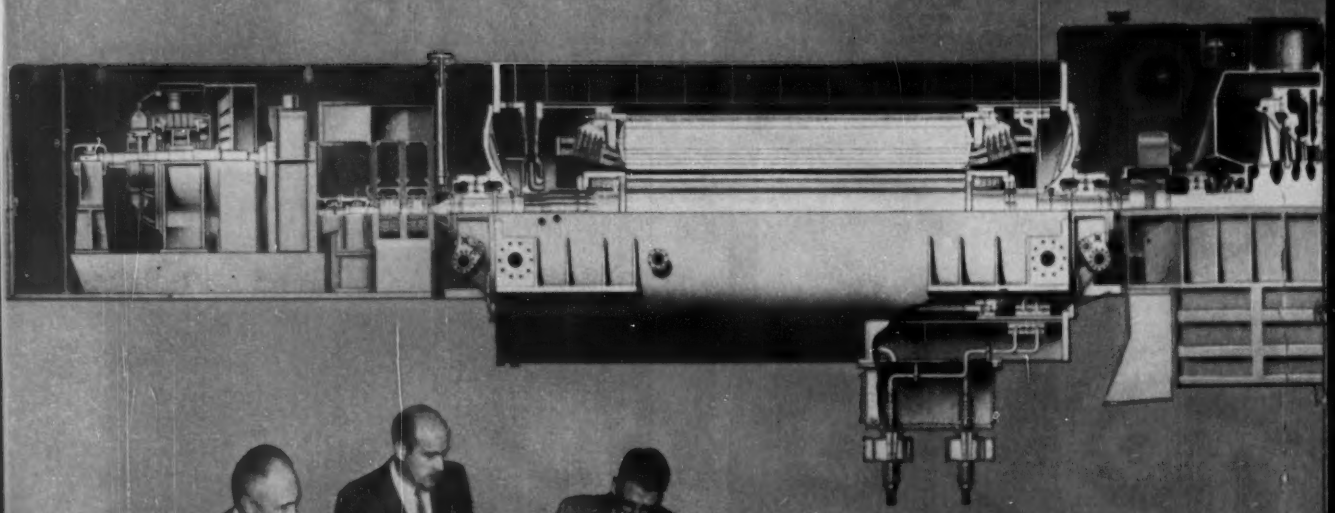


Panel provides centralized control of soot blowing at Eddystone. With the Vulcan SSC-120 Selective-Sequence controller, each blower can be operated four times during a schedule, or there can be four different schedules. The sequence can be varied by means of a jack board. Any soot blower can be operated at any point in the sequence by plugging one end of a patch cord into the blower jack, and the other end into the desired sequence jack. Write for Bulletin 1029.

Wall deslagger conserves steam generated at Eddystone by three special package boilers. High striking power of Vulcan RW-3E drives off gummy masses to assure high heat-transfer capacity, and uniform superheat and reheat temperature control. Dual motors are used: one speeds the nozzle to and from the blowing position, the other rotates it slowly for thorough cleaning. All parts are covered for protection, assuring long life with low maintenance. Write for Bulletin 1034.

Vulcan T-30's have 30- and 37-foot travels. Motors are mounted at the boiler end to facilitate maintenance, yet away from heat of the boiler wall. Their placement avoids interferences. Write for Bulletin 1030.

For more facts circle 209 on Reader Service card, p 117

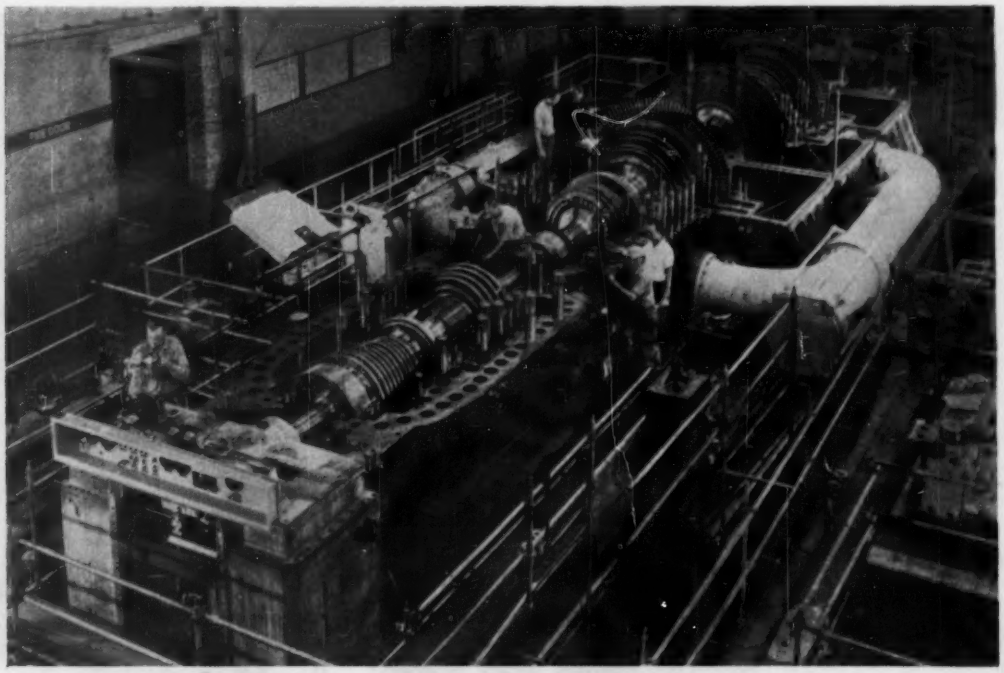


Design Firsts by Allis-Chalmers

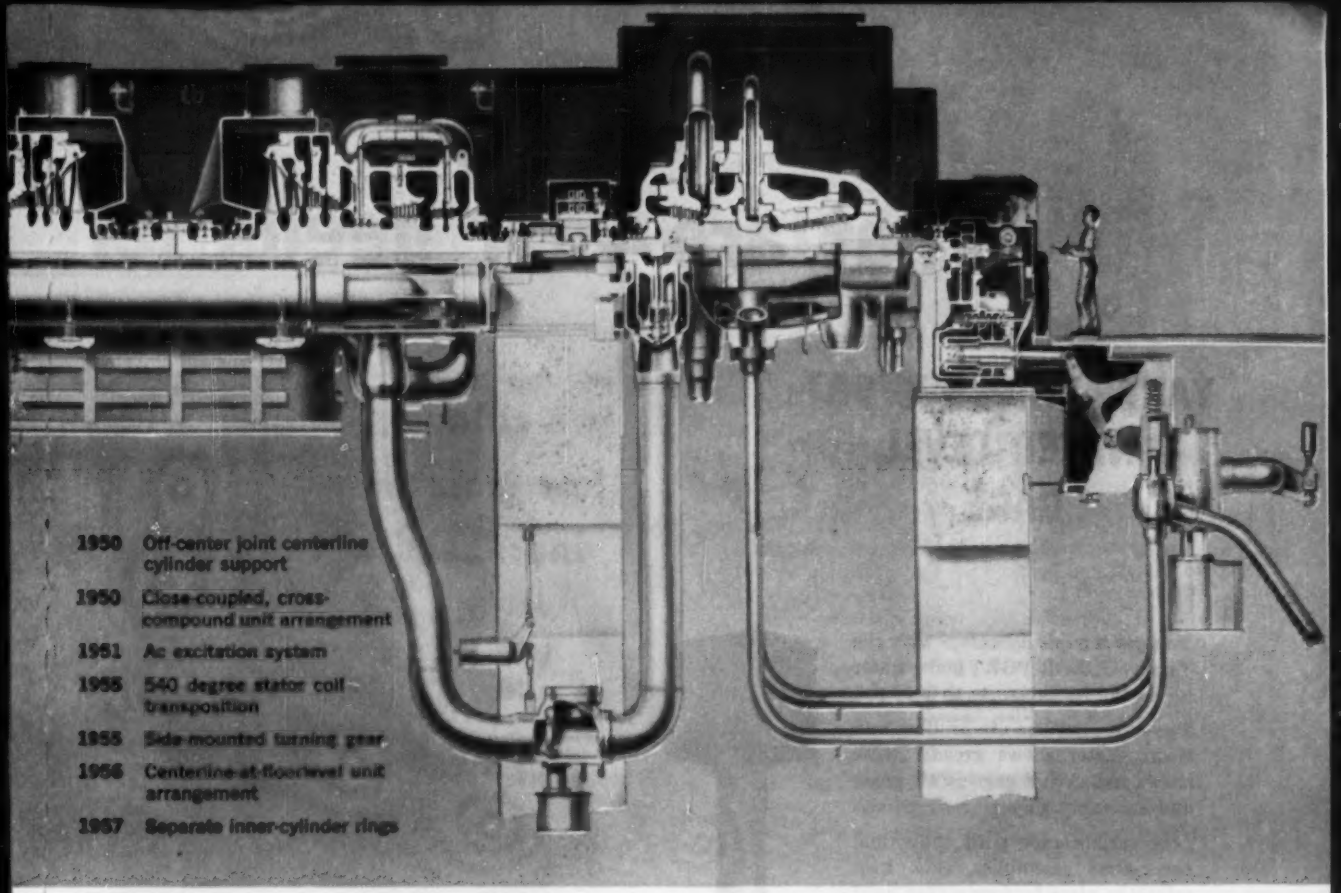
1926	Side-crossunders
1934	Separate nozzle chests
1936	Thrust-type hydrogen seals
1941	Nonsliding thrust-bearing pedestals
1948	Supercharged axial ventilation

Designing today for tomorrow's power needs, Allis-Chalmers experienced, forward-thinking engineering staff has pioneered higher ratings and unique arrangements for steam turbine-generator units . . . originated and patented many of the design features now adopted as industry standards for such equipment.

PACING



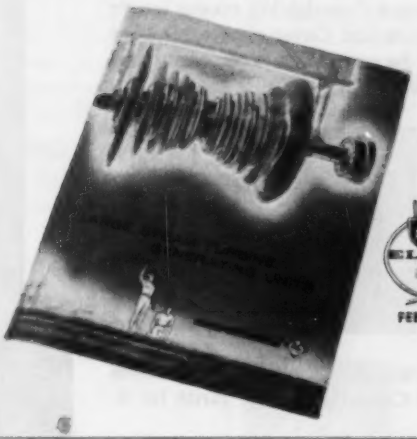
Engineering know-how and the results of extensive research and development programs are confirmed on the large turbine test pits. During the past few years A-C has spent millions of dollars expanding and modernizing manufacturing facilities like these to assure that design excellence created on the drawing board is translated into the finished product.


1950 Off-center joint centerline cylinder support
1950 Close-coupled, cross-compound unit arrangement
1951 Ac excitation system
1955 540 degree stator coil transposition
1955 Side-mounted turning gear
1956 Centerline-at-floorlevel unit arrangement
1957 Separate inner-cylinder rings

POWER PROGRESS ...by design!

An Allis-Chalmers tandem triple-flow steam turbine-generator unit, for example, incorporates such industry-recognized A-C developments as . . . centerline-supported inner and outer high-temperature cylinders; thrust-balanced turbine elements with high-temperature steam confined to a single shaft of small diameter; separate below-floor front-mounted steam chest; and separate ring-type nozzle chest in a center-inlet high-pressure turbine. Also, hydrostatic thrust-bearing-type shaft seals for the fully supercharged generator.

These advanced design concepts add to Allis-Chalmers growing list of firsts — set new industry standards for performance and continue the pattern by which A-C paces power progress . . . ahead of utility requirements.



NATIONAL ELECTRICAL WEEK
FEBRUARY 7-13, 1960

NEW BULLETIN

For more information on these and other outstanding design features of Allis-Chalmers line of reheat steam turbine-generator units, contact your nearest A-C office for Bulletin 03B9448. Forty pages, illustrated by more than 100 photographs, tell how A-C is pacing power progress.

ALLIS-CHALMERS

A-1212

For more facts circle 210 on Reader Service card, p 117

What are your needs for

YARWAY COLOR-PORT WATER LEVEL GAGE

You get a *triple advantage* with the Yarway COLOR-PORT boiler water level gage for pressures to 3000 psi.

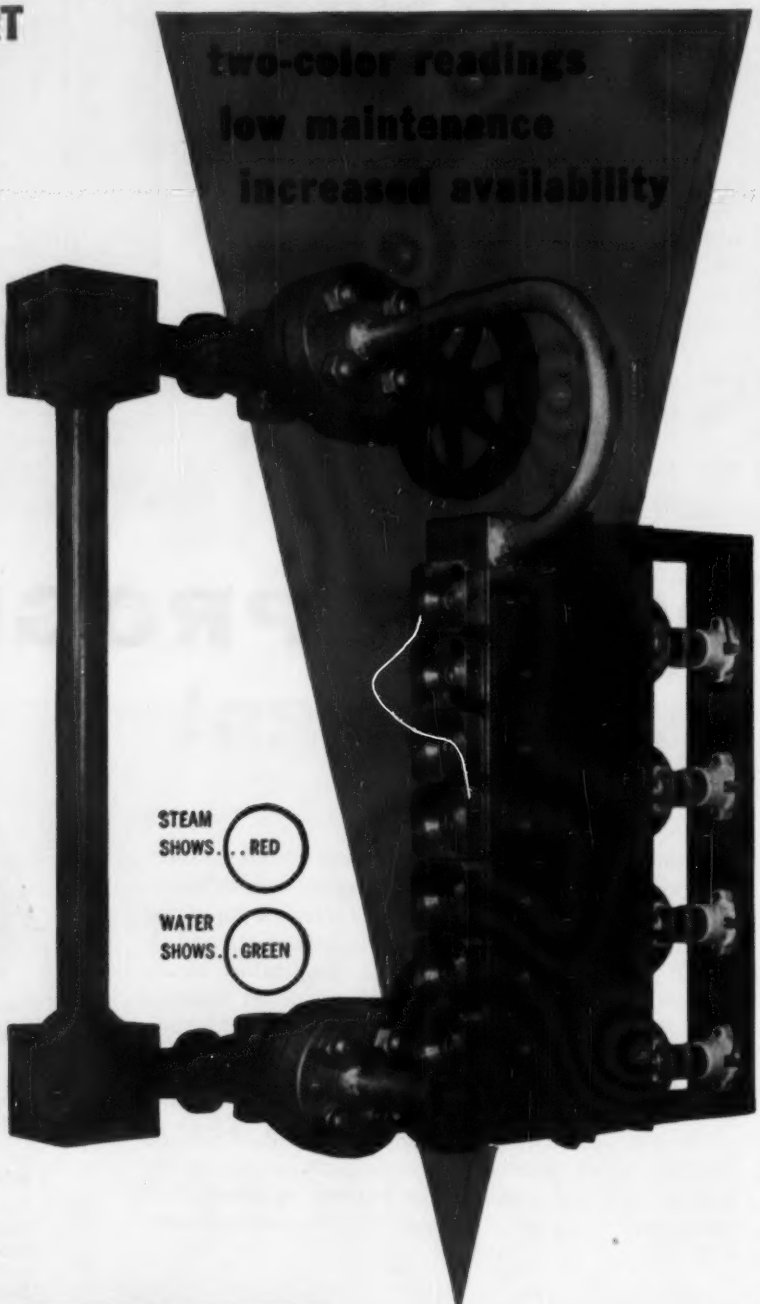
Two-color readings are brilliant and clear. Water shows green; steam shows red. A full gage is all green and an empty gage all red.

Low maintenance with individual cover-glass assemblies, each held solidly in place by four socket head cap screws. "Floating assembly" design applies safe, predetermined loads on glass ports, reducing thermal shocks, permitting faster warm-up.

Increased availability means longer service life. Cover glass assemblies can be *serviced in place*, easily and quickly.

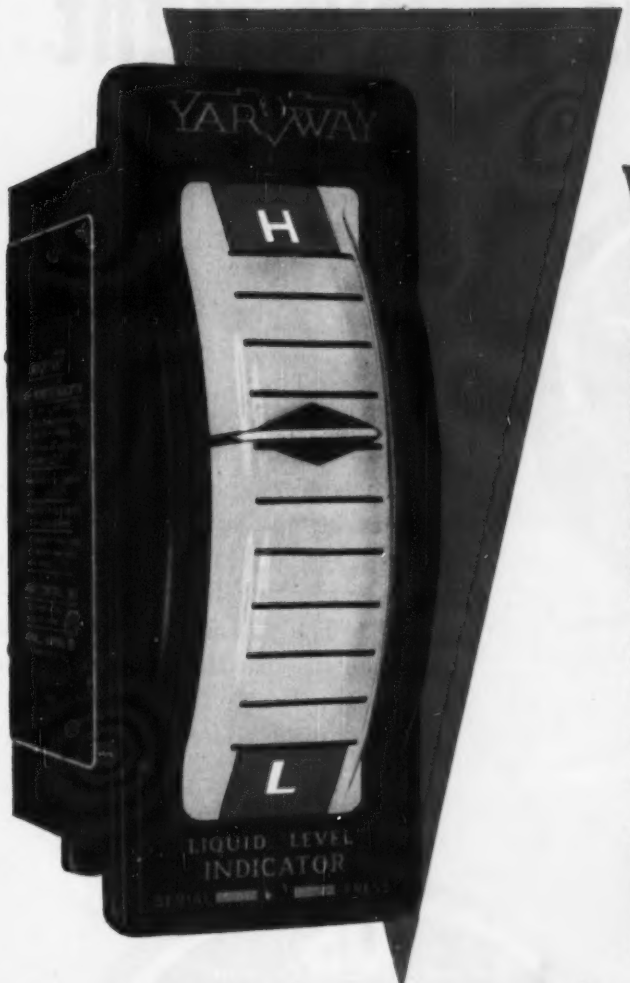
Yarway Bulletin WG-1814 describes the Color-Port Gage. Write for it.

YARNALL-WARING COMPANY
100 Mermaid Avenue
Philadelphia 18, Pa.
Branch Offices in Principal Cities



YARWAY COLOR-PORT . . . *a good way to specify high pressure water gages*

boiler water level indication ?



YARWAY REMOTE LIQUID LEVEL INDICATORS

Boiler water levels and other liquid levels requiring remote indication can be handled completely by a Yarway system.

Heart of the system is the Yarway Remote Liquid Level Indicator that gives instant, accurate readings because the mechanism is operated by the boiler water or other liquid itself. The pointer mechanism is never under pressure. Clear, "wide vision" face permits easy readings from any angle.

The Yarway Indicator conforms with A.S.M.E. Boiler Code Committee ruling (Case #1155) permitting two independent remote level indicators of compensated manometric type to replace one of two required gage glasses for boiler pressures 900 psi and above.

Electronic Secondary Indicators can be added at any point in the plant. Remote Hi-Lo Alarm Signals (lights and/or horns) can be connected for additional safety.

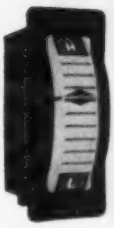
Primary indicators fully compensated for every pressure change in boiler also available.

For permanent record of changing levels, the Yarway Hi-Lo-Graph Recorder can be furnished.

Over 10,000 Yarway Remote Indicators have already been installed. For full details, write for Yarway Bulletin WG-1824.

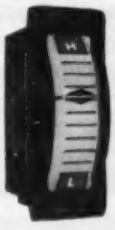
YARNALL-WARING COMPANY
100 Mermaid Avenue, Philadelphia 18, Pa.
Branch Offices in Principal Cities

FULLY COMPENSATED INDICATORS



for completely accurate indication under every boiler operating condition

ELECTRONIC SECONDARY INDICATORS



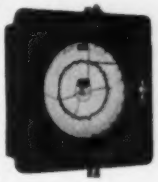
To supply additional indication at any point without pressure connections.

REMOTE SIGNALS

Hi-Lo Alarms Lights and/or Horns

RECORDERS

To provide permanent 24-hour record of liquid levels.



YARWAY

. . . a good way to specify remote liquid level indicators

For more facts circle 211 on Reader Service card, p 117

US RUBBER TAPES

The Splice is always right

U. S. GRAY PERFECTION TAPE

Made of the strongest fabric, impregnated to every fiber with pure rubber. This U.S. Rubber method of manufacturing eliminates pinholes. The tape has the strongest adhesion. U.S. Gray Perfection Tape will not dry out. Here is a tape that not only meets specifications, but exceeds them.

United States Rubber produces tape for every insulation and splicing need. "U.S." engineers know exactly what is required of any splicing compound, whatever the application. Simplify your purchasing by ordering from *one* line — the "U.S." line. Get in touch with any of our numerous distributors or one of our strategically located Branch Sales Offices, or write to address below.

USCO SPLICING COMPOUND

High dielectric resistance makes it especially suitable for high voltage work on railroads, power lines and signal lines. Usco is waterproof and always durable.

...and so is the price!

¾ IN. WIDE
US RUBBER
30 FEET
Uskorona
SPLICING COMPOUND
OZONE AND MOISTURE RESISTING COMPOUND
Uskorona combines maximum resistance to OZONE and MOISTURE with high tensile strength, elongation and dielectric resistance. Fuses quickly without heat or pressure and makes
PERFECT
SPLICES
Made in USA
UNITED STATES RUBBER CO. PASSAIC, N.J.

USKORONA® SPLICING COMPOUND

This is the ozone- and moisture-resistant type for overhead splicing where high dielectric protection is needed. Uskorona fuses quickly without heat or pressure and makes the splice an inseparable part of the original insulation. Uskorona is superior in tensile strength, durability and moisture absorption. Use the time-proven Uskorona splicing compound—and be *sure*.

When you think of rubber, think of your "U. S." Distributor. He's your best on-the-spot source of technical aid, quick delivery and quality industrial rubber products.

Mechanical Goods Division

United States Rubber

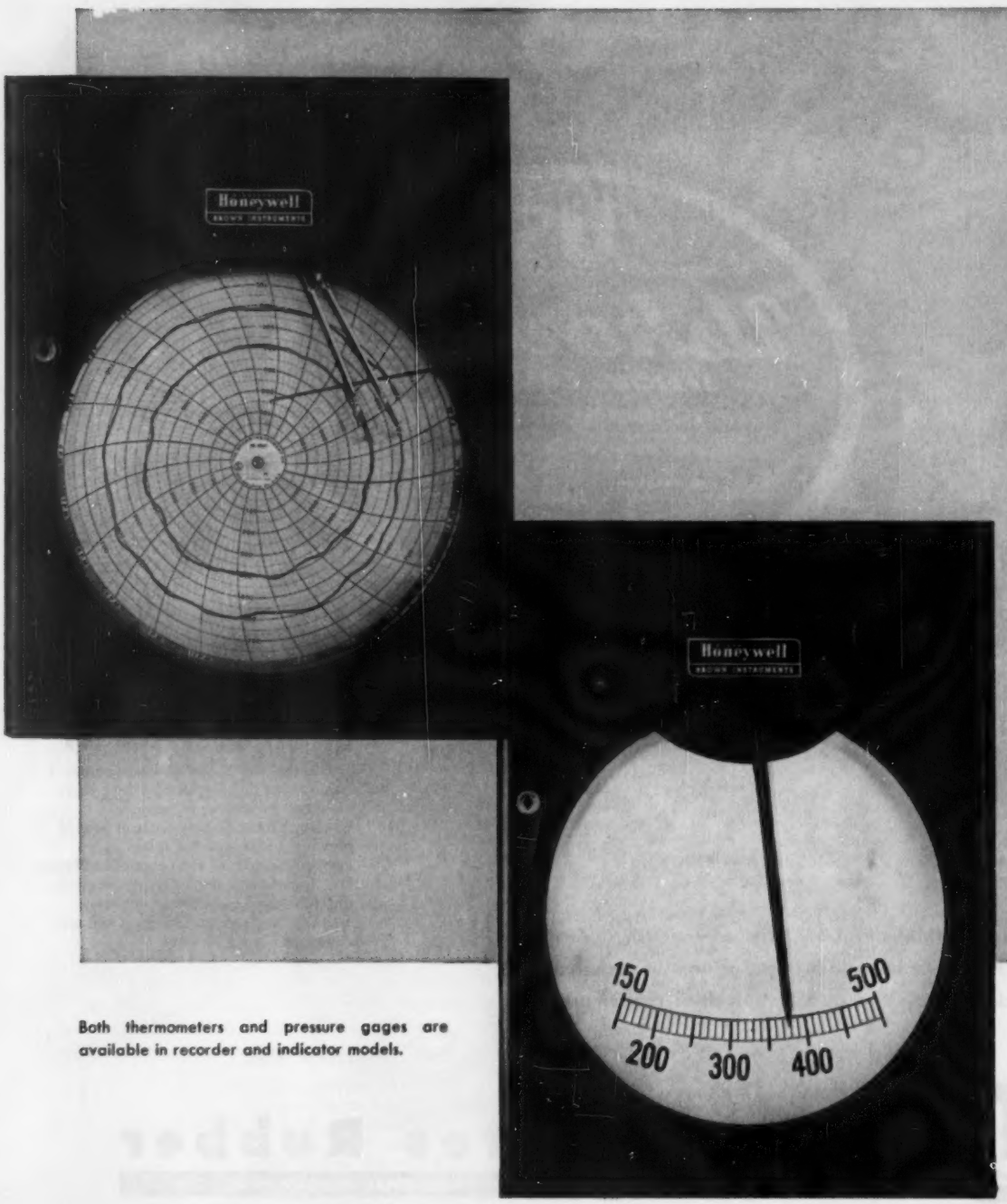
WORLD'S CARGEST MANUFACTURER OF INDUSTRIAL RUBBER PRODUCTS

Rockefeller Center, New York 20, N.Y. In Canada: Dominion Rubber Company, Ltd.

For more facts circle 212 on Reader Service card, p 117

Choose from thousands of Honeywell

Temperature



Both thermometers and pressure gages are available in recorder and indicator models.

instruments to measure and control

and Pressure

The enormous variety of options available in Honeywell thermometers and pressure gages gives you custom design in standard instruments. Choose from *thousands* of combinations of pressure and thermal elements, chart and scale ranges, transmitting, receiving and pneumatic or electric control units.

Use Honeywell thermometers to measure temperatures from −125°F to 1000°F, with accuracy of ±1%. Measure pressures as high as 4000 psi and as low as 5 inches of water vacuum with Honeywell pressure gages.

Whatever your requirements in temperature and pressure measurement and control, there's a Honeywell instrument virtually made to order for you. Get complete details from your nearby Honeywell field engineer. Call him today . . . he's as near as your phone.

MINNEAPOLIS-HONEYWELL, Wayne and Windrim Avenues, Philadelphia 44, Pa.

CONTROL COMBINATIONS AND OPTIONS

TEMPERATURE

Thermal systems—vapor, mercury, or gas actuated, case, case and capillary, or self-compensated.

Bulb styles—plain, union-connected, averaging, preformed capillary, rigid extension, dairy, wet and dry bulb assemblies, self-contained thermal systems.

Electric control—*Electr-O-Vane*, spst (on-off control), spdt (two-position control), sp3t (three-position control).

Pneumatic control—*On-Off*
10% Throttler (1 to 10% proportional band, manual reset).
Full Throttler (1 to 150% proportional band, manual reset).
Air-O-Line (1 to 150% proportional band, automatic reset).

For complete information, write for Catalog ▶ C-60-2.

PRESSURE

Pressure and vacuum elements—spiral, intermediate-range spring and bellows, low-range spring and bellows, dual spring and bellows for absolute pressure.

Electric control—*Electr-O-Vane*, spst (on-off control), spdt (two-position control), sp3t (three-position control).

Pneumatic control—*On-Off*
10% Throttler (1 to 10% proportional band, manual reset).
Full Throttler (1 to 150% proportional band, manual reset).
Air-O-Line (1 to 150% proportional band, automatic reset).

For complete information, write for Catalog ▶ C-70-1.

75th YEAR
PIONEERING THE FUTURE

Honeywell
First in Control
SINCE 1885

For more facts circle 213 on Reader Service card, p 117

SAVINGS up to 20% on CONVEYOR COSTS
12 to 60% GREATER HAULING CAPACITY

... possible with

RAY-MAN CONVEYOR BELT

It's a mathematical certainty that a belt can haul bigger loads with 45° idlers than with regular 20° idlers. But the 45° angle between concentrating idlers and bottom roll idlers is too sharp for an ordinary heavy duty conveyor belt. Plies separate, but modern RAY-MAN CONVEYOR BELT licks this problem . . . for all time!

Ray-Man's exclusive flexible construction and built-in stress compensation are guaranteed to take the sharp angle of 45° idlers without ply or cover separation at the hinge line. This opens a whole new era of conveyor design . . . permitting larger loads . . . narrower conveyors . . . assuring longer cover wear . . . lower handling costs!

Ask your R/M representative to show you how Ray-Man Conveyor Belt with 45° idlers can give you the most for your conveyor dollar . . . write for new Bulletin M303, "Ray-Man for 45° Idlers."

RAY-MAN BELT IS BUILT TO TAKE THE EXTRA STRESS OF 45° IDLERS

BIGGER LOADS, LESS SPILLAGE, LESS WEAR ON COVER WITH 45° IDLERS

20° IDLERS REQUIRE WIDER CONVEYOR TO HAUL SAME TONNAGE

ORDINARY PLY BELTS ARE TOO BOARDY TO TAKE 45° IDLERS

RAY-MAN IS GUARANTEED NOT TO PLY-SEPARATE AT 45° ANGLES

RAYBESTOS-MANHATTAN, INC.
MANHATTAN RUBBER DIVISION, PASSAIC, NEW JERSEY

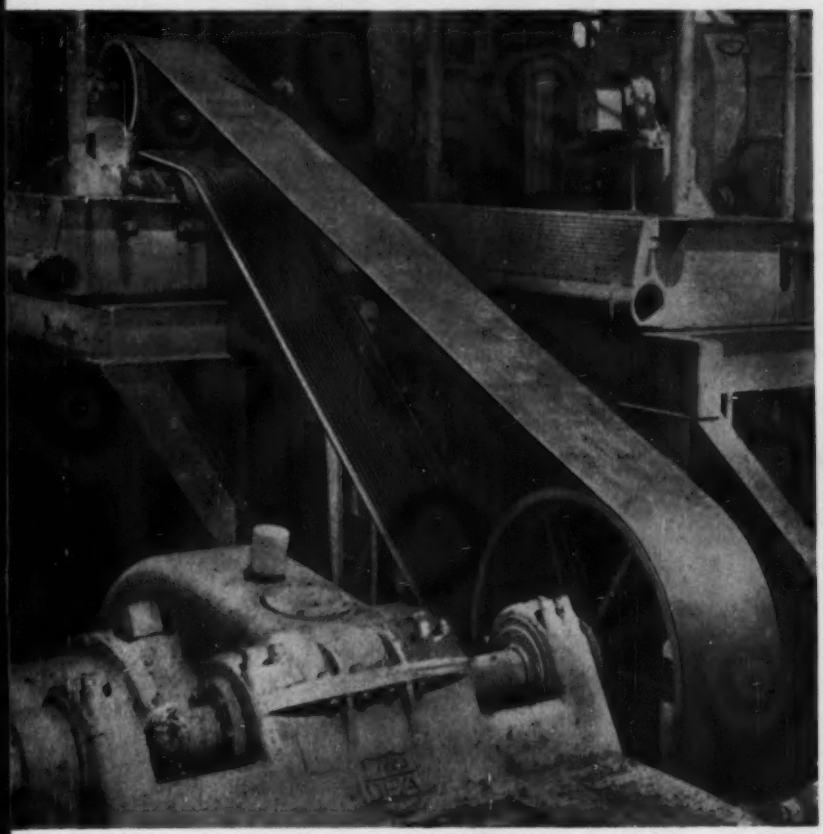
R/M

ENGINEERED RUBBER PRODUCTS ..."MORE USE PER DOLLAR"

HOMOFLEX HOSE IS MORE FLEXIBLE, WEIGHS LESS THAN ANY HOSE FOR EQUAL PRESSURE

- FLEXIBLE AS A ROPE
- SUPER-STRONG
- NO PRE-SET TWIST—WILL NOT KINK
- UNIFORM INSIDE & OUTSIDE DIAMETERS
- INSEPARABLE TUBE-TO-COVER BOND
- EASIER, SAFER COUPLING
- FASTER, FULLER FLOW
- "MORE USE PER DOLLAR"

Let your R/M Distributor show you the advantages of Homoflex for air, water, other fluid and gases; also other types of R/M rubber hose for your job applications. Write for Bulletins M610 and M694.



CONVERT TO R/M POLY-V® DRIVE FOR MORE POWER IN LESS SPACE... *with Reliability*

- SINGLE UNIT V-RIBBED DESIGN—Flat belts are also single units
- ELIMINATES BELT "MATCHING" PROBLEMS
- MAINTAINS GROOVE SHAPE
- CONSTANT PITCH AND SPEED RATIOS
- LESS WEAR ON BELT AND SHEAVES
- COMPLETE CONTACT-PRESSURE

Just two Poly-V belt cross sections meet every heavy duty power transmission requirement.

R/M Poly-V* Drive is the smoothest and coolest running —*longest wearing* drive you can install. Discuss your application with an R/M Distributor . . . or write for Poly-V* Drive Bulletin M141.

**Poly-V is patented by Raybestos-Manhattan, Inc.*

RM-1031

THE RIGHT THERMOSTAT FOR EVERY PURPOSE

ROOM THERMOSTATS
Single-temperature, dual-temperature (day-night, heating-cooling), and submaster thermostats in a wide selection of models. Proportional or two-position action. Direct or reverse acting. Sensitive bimetallic measuring elements. Wide selection of adjusting features.

HEATING-COOLING THERMOSTATS
Two-pipe room types with two bimetallic measuring elements and concealed types with remote bulb liquid filled measuring elements. Direct acting for heating; reverse acting for cooling. Proportional action. Manual or automatic change-over. Choice of adjusting features.

INSERTION THERMOSTATS
Available with liquid-filled sensitive elements and rod-and-tube type sensitive elements. Rigid stem. Proportional or two-position action. Direct or reverse acting. Adjustable sensitivities. Available with pneumatic follow-up movement (pneumatic feedback) for extreme accuracy at low sensitivities.

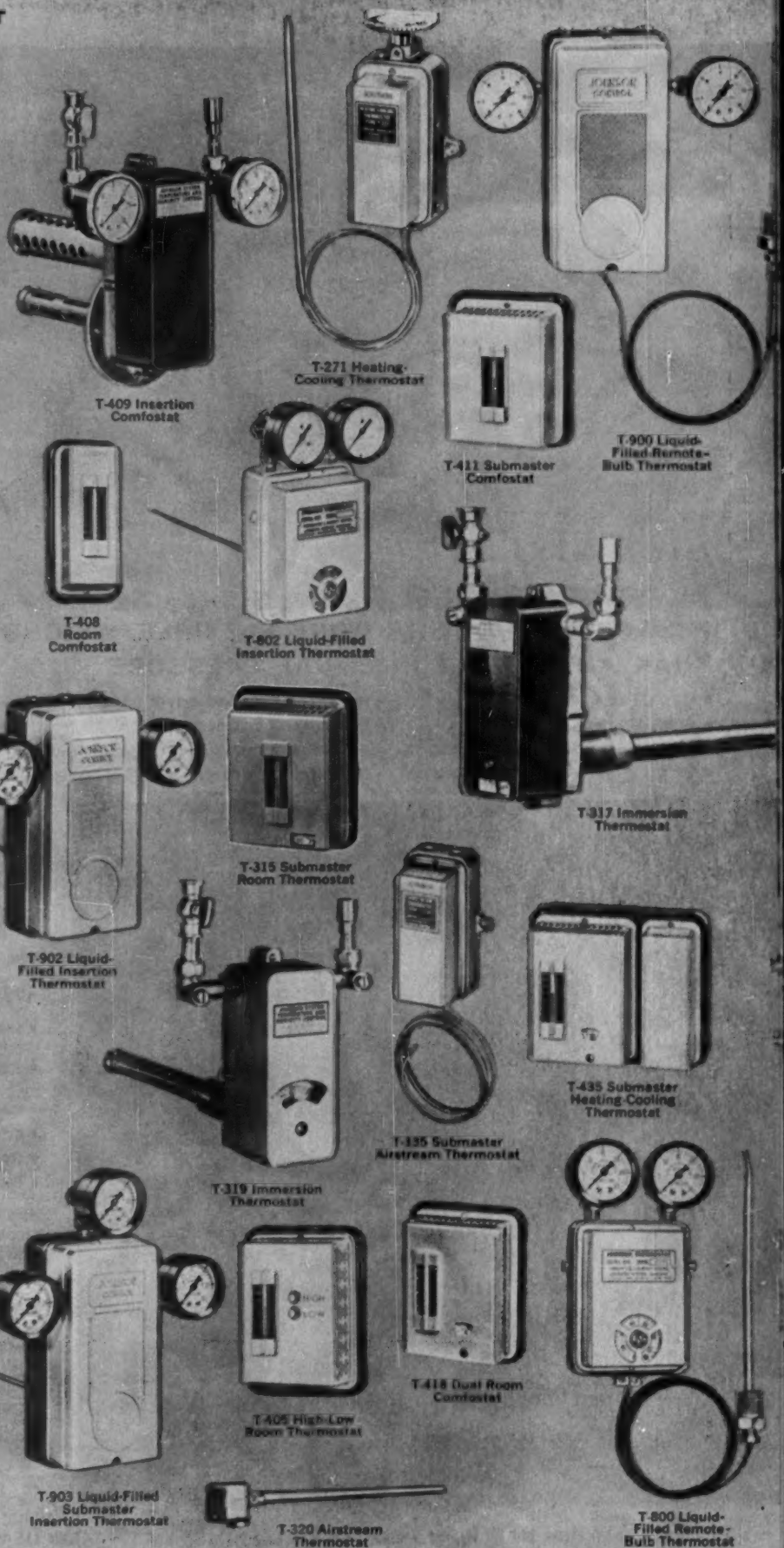
IMMERSION THERMOSTATS
Wide choice of models with same selection of features as Insertion Thermostats.

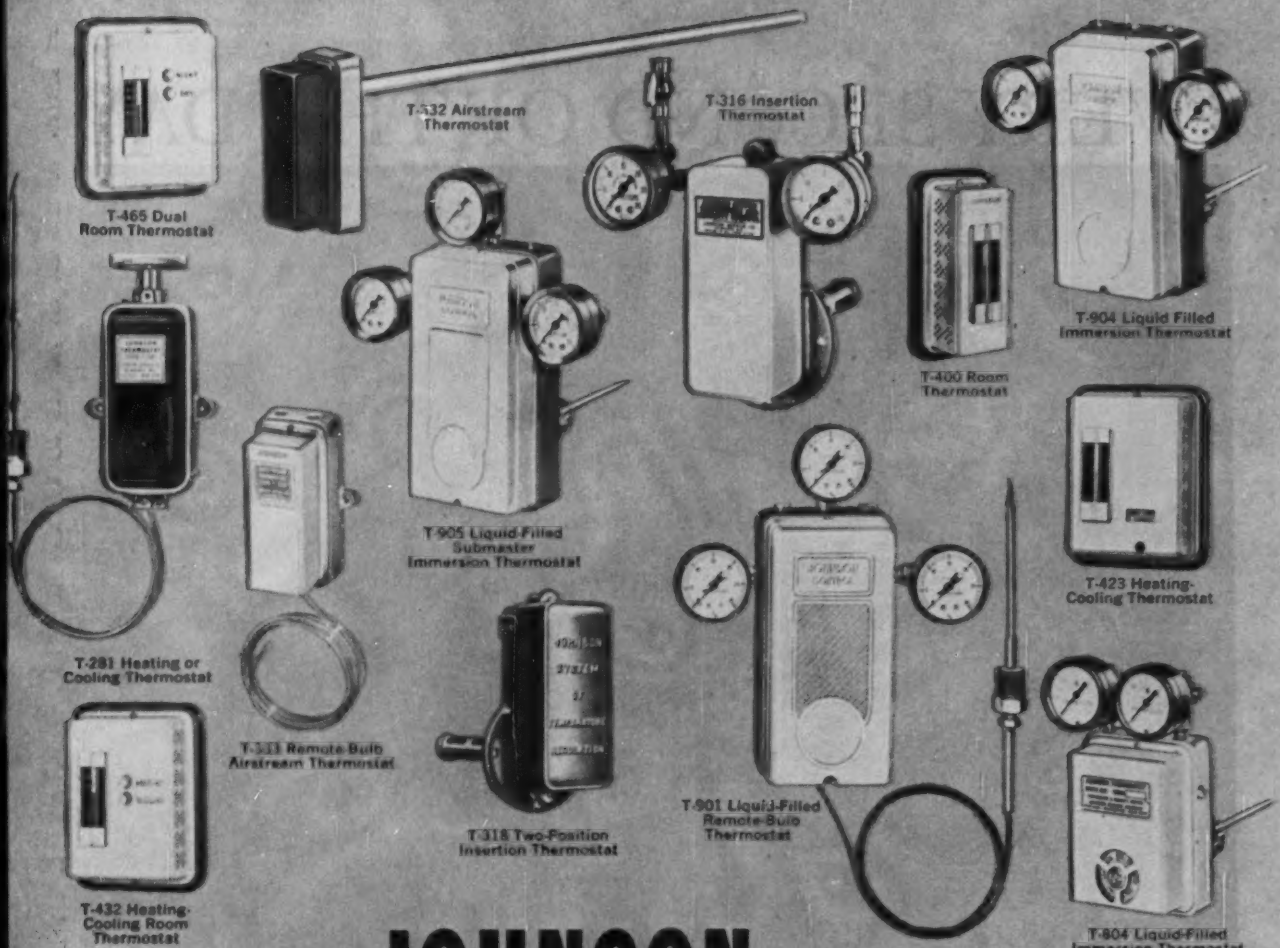
REMOTE BULB THERMOSTATS
For applications requiring location of thermostat at a distance from the point of temperature measurement. Liquid-filled measuring elements with capillary lengths to 85 ft. Proportional or two-position action. May be converted from direct to reverse acting. Available with follow-up movement (pneumatic feedback) for accurate control at low sensitivities.

SUBMASTER THERMOSTATS
Insertion, immersion and remote-bulb types. Set point may be varied from a remote point by action of another (master) controller. Available with liquid-filled stem and remote-bulb measuring elements. Direct or reverse acting. Proportional or two-position action.

AIRSTREAM THERMOSTATS
Available with flexible 8-ft. liquid-filled averaging element or rod-and-tube type element. Direct acting, proportional action. Adjustable sensitivity. One- and two-pipe models.

COMFOSTATS
An exclusive Johnson instrument that controls from "effective" temperatures, regulating temperature in proportion to changes in relative humidity. Bimetallic temperature measuring elements; choice of humidity elements. Proportional action. Direct or reverse acting. Single- and dual-temperature room types, insertion type, and submaster type models available.





JOHNSON THERMOSTATS

for Air-Conditioning, Heating, Ventilating, and Process Control

"The right equipment, properly applied" has always been a basic Johnson rule. That's why Johnson makes the most complete line of pneumatic control equipment in the industry, including, of course, a thermostat for every application.

JOHNSON CONTROL

PNEUMATIC SYSTEMS

DESIGN • MANUFACTURE • INSTALLATION • SINCE 1885

JOHNSON SERVICE COMPANY
507 East Michigan Street, Milwaukee 1, Wisconsin

- ☐ Have a Johnson engineer call on me.
- ☐ Send your new condensed catalog of all types of Johnson Pneumatic Control equipment.

Name_____

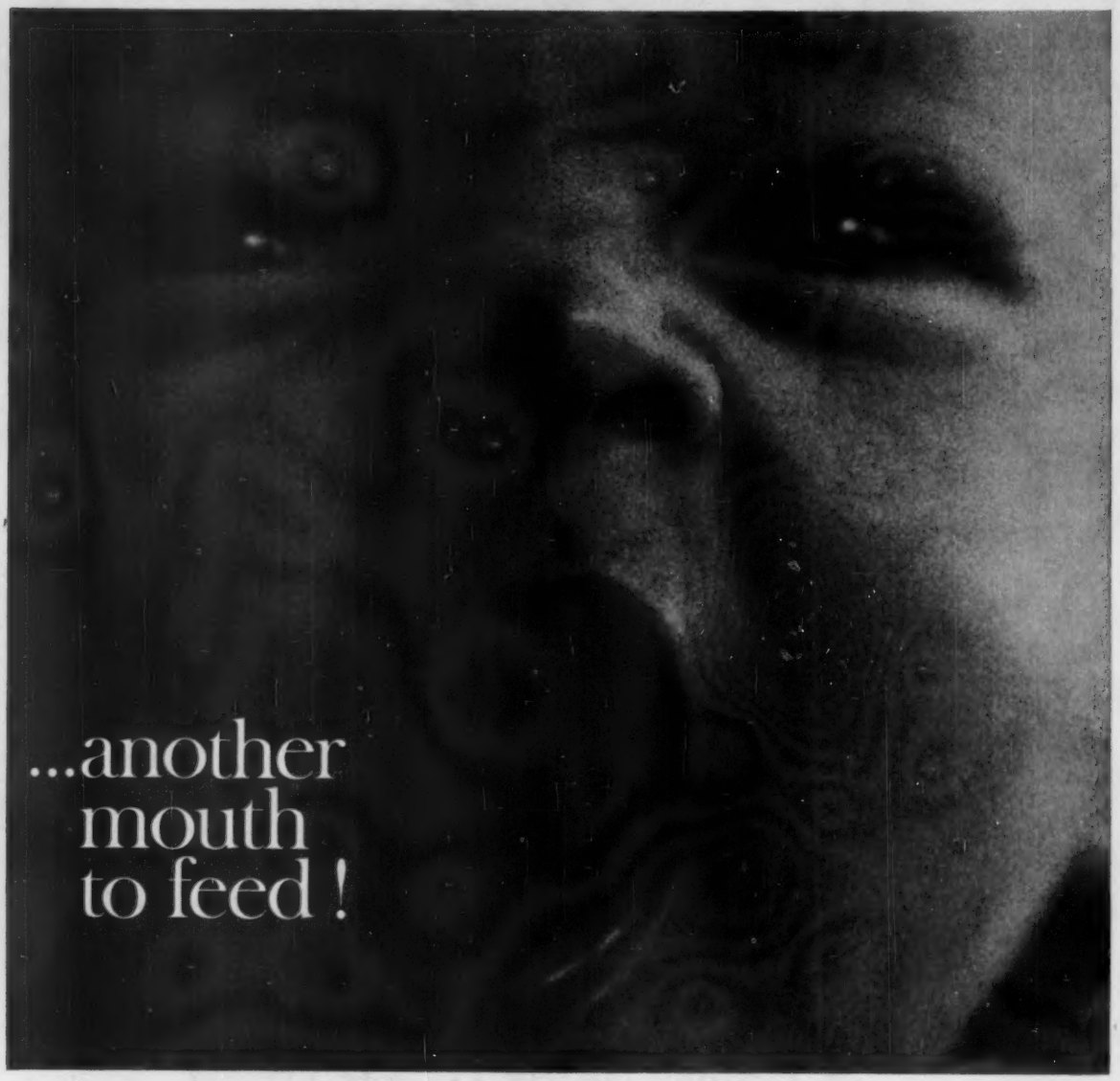
Title_____

Firm_____

Address_____

City_____ State_____

EVERY SECOND OF THE DAY



What is Hawker Siddeley doing here?

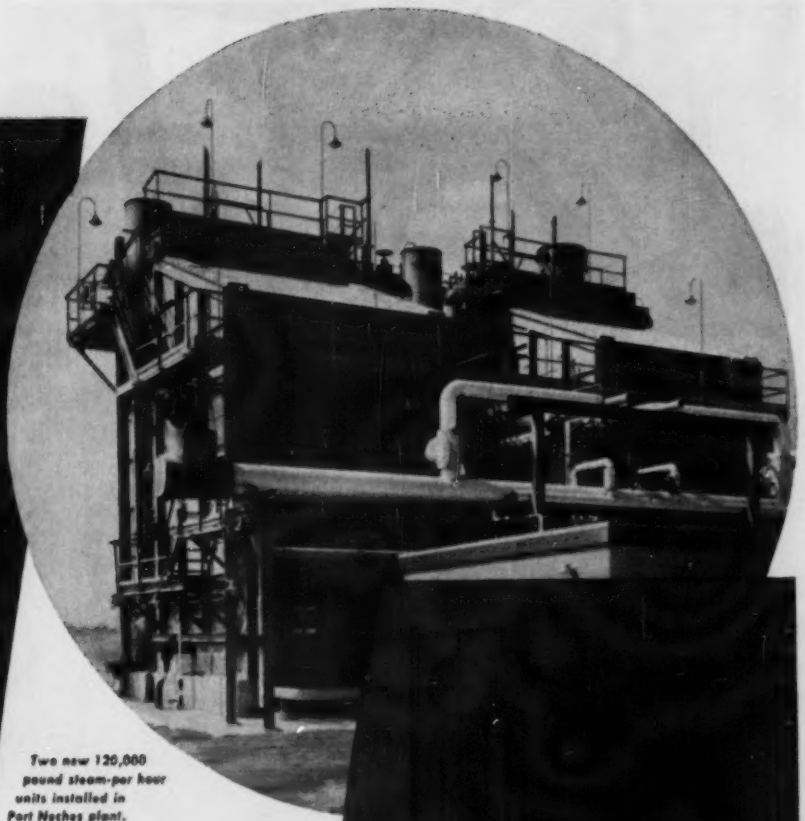
Five hundred years ago wise men warned that the world might run short of food. Every year from then until now the world has been haunted by the fear of too many people, too little food. □ Yet today more people are better fed than ever before. The earth shows no limit to her productivity. This is the miracle of machinery . . . power plants that multiply the work of men's hands, diesels that plough and harvest and carry food from village to town or from one end of the world to the other; the kind of power equipment that Petters Limited, a member of the Hawker Siddeley Group, make and install in countries all over the world. □ Whenever, wherever you have reason to wonder "Who can do this?", tap the vast resources of the Hawker Siddeley Group. You will find a representative in your part of the world who can help and advise you. **HAWKER SIDDELEY GROUP**

International Sales: Duke's Court, St. James's, London, S.W.1

HAWKER SIDDELEY INDUSTRIES:
BRUSH ELECTRICAL · FULLER ELECTRIC · HAWKER SIDDELEY BRUSH TURBINES · HAWKER SIDDELEY NUCLEAR POWER · MIRRLEES ENGINES · NATIONAL ENGINES PETTERS · HAWKER SIDDELEY HAMBLE · HIGH DUTY ALLOYS · McLAREN FABRICATIONS · KELVIN CONSTRUCTION · NORSTEL & TEMPLEWOOD HAWKSLEY

For more facts circle 216 on Reader Service card, p 117

Steam for Jefferson Chemical by Vogt



Two new 120,000 pound steam-per hour units installed in Port Neches plant.

The needed additional power and process steam capacity for Jefferson Chemical's expanded Port Neches plant is furnished by the two Vogt boilers pictured here, each with a capacity of 120,000 pounds per hour. The boilers are designed for 675 lbs. pressure to operate at 625 lbs. pressure and 769°F. total temperature. The furnaces are equipped with gas burners and have water cooled front and side walls.

Bulletins describing Vogt boiler installations in a variety of industrial plants for power, processing and heating are available on request.

Installation by C. F. Braun and Co., Engineers.

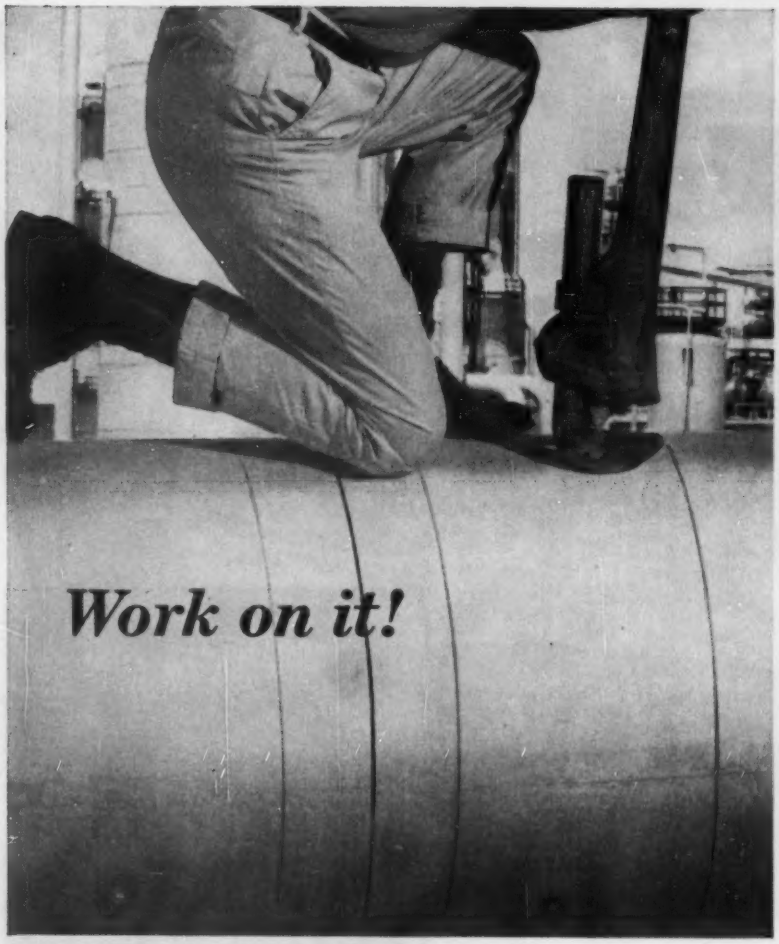
For Custom Installation Bulletin VF-VS-2 • Package Unit Bulletin PSG-3, address Dept. 24A-BP.

HENRY VOGT MACHINE CO., LOUISVILLE, KENTUCKY

SALES OFFICES: New York, Chicago, Cleveland, Dallas, Camden, N.J., St. Louis, Charleston, W.Va., Cincinnati

STEAM GENERATORS

For more facts circle 217 on Reader Service card, p 117



J-M's new Metal-On® insulation is Thermobestos prejacketed in aluminum. Snaps on pipe quickly . . . surely. Saves the time and cost of separate on-the-job metal application.

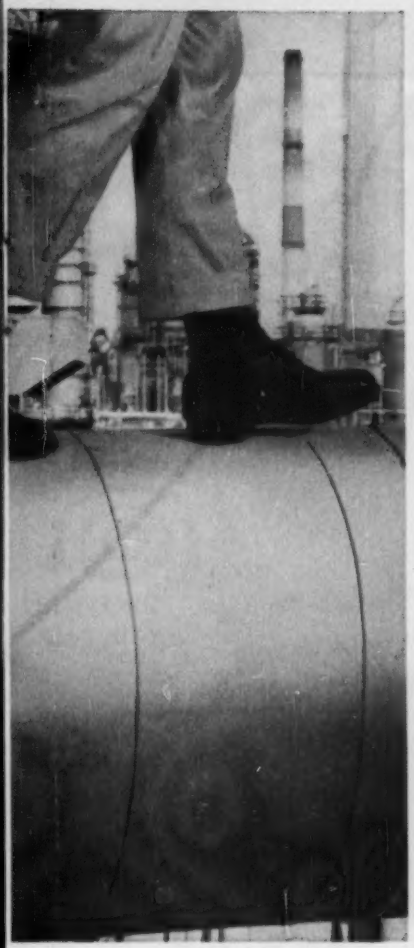
Seminars on best installation practices. For plant foremen who wish to keep up to date on new insulation methods and installation practices, J-M regional sales offices will gladly conduct insulation seminars. Contact nearest J-M office.

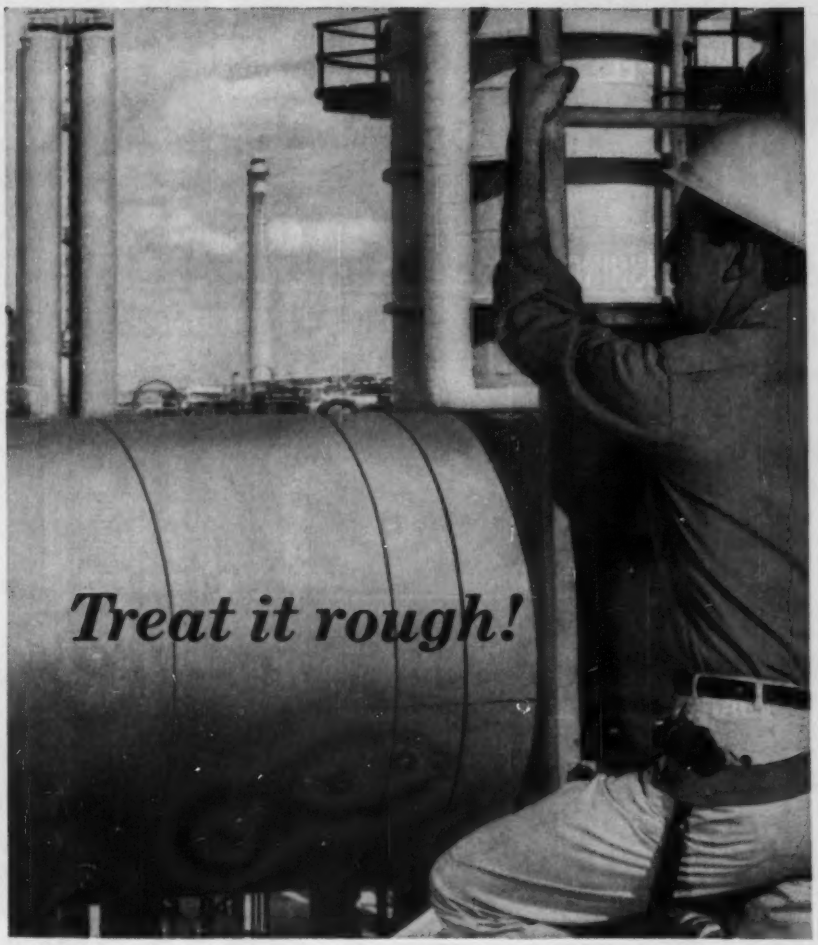
It's tough, durable Johns-Manville

Here's why Thermobestos is the preferred high-temperature calcium-silicate insulation . . . to 1200 F

You know the kind of treatment pipe insulation must take . . . day after day, year after year!

There's no better reason than this for the spiraling growth in Thermobestos® applications throughout the process and power generation industries —an insulation so strong and rigid, so resistant to crushing and compression it is almost structural.





THERMOBESTOS insulation!

Equally important is the ability of Thermobestos to keep fuel costs low. Its *k* factor is the lowest of all insulations generally accepted for process applications. Its moisture resistance, unsurpassed.

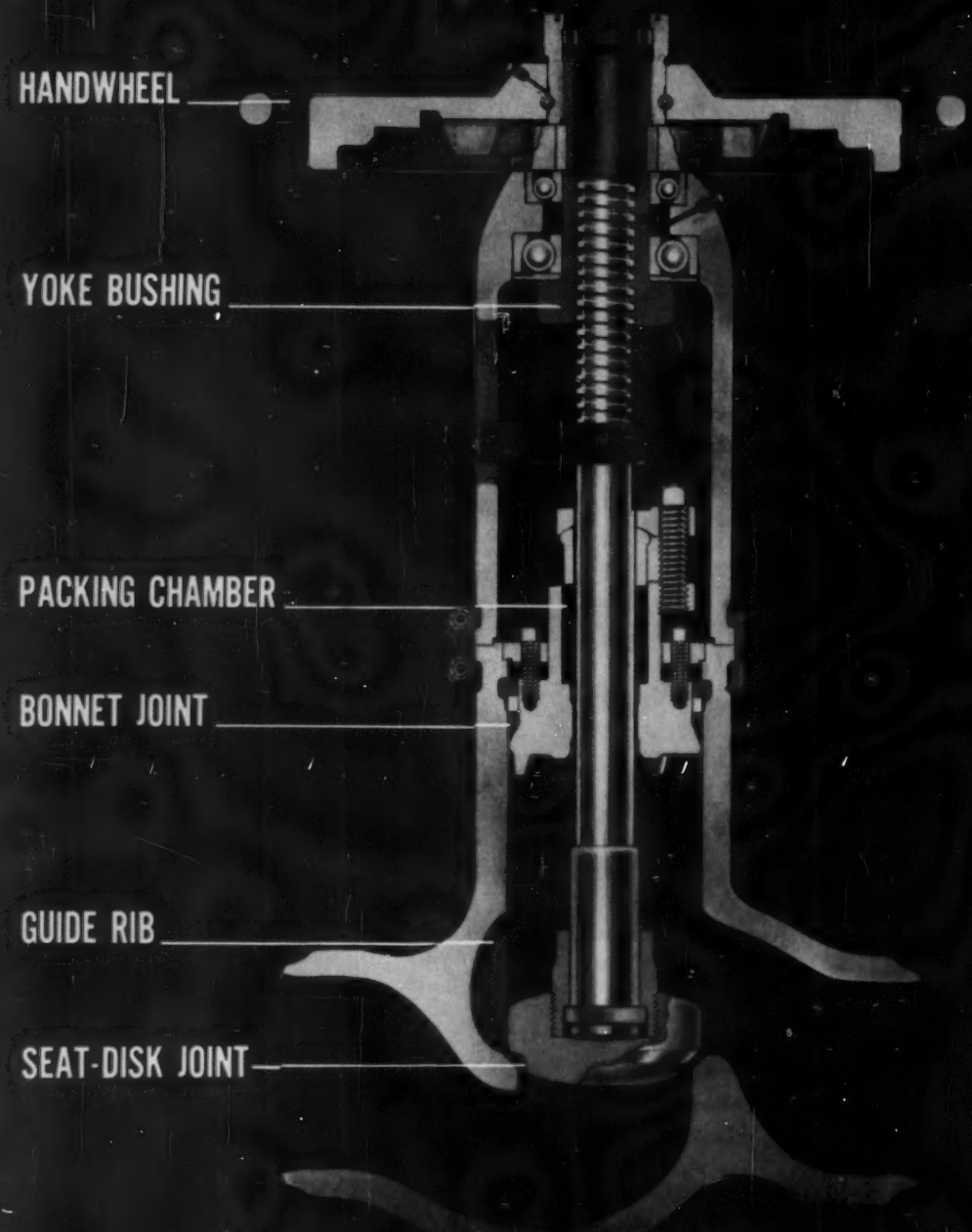
Furnished in large, lightweight sections—precision-molded to unusually close tolerances—Thermobestos is easy to handle and install . . . readily adaptable to shop fabrication of fittings and bonds. Large selection of sizes, thicknesses (and quads up to 33″ pipe size) permit calcium-silicate installations that are entirely Thermobestos insulation.

You'll want the new Thermobestos booklet for your technical file. It contains complete information on prefabricating and installation practices . . . specification data . . . heat transmission tables . . . and physical and thermal characteristics. Write for it today. Ask for booklet IN-169A. Address Johns-Manville, Box 14, New York 16, N.Y. In Canada, 565 Lakeshore Rd. East, Port Credit, Ontario.

JOHNS MANVILLE JM PRODUCTS

JOHNS-MANVILLE

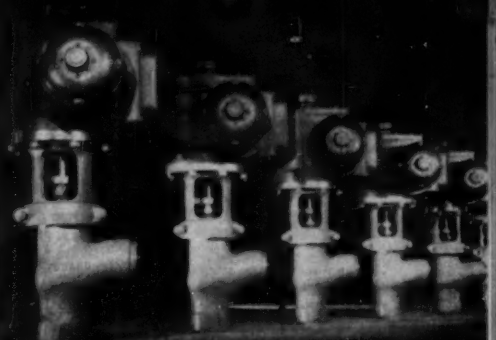
For more f cts circle 218 on Reader Service card, p 117



EDWARD CAST STEEL
GLOBE VALVE FIG. 4016Y

IMPACTOGEAR® OPERATED VALVE

MOTOR OPERATED VALVE



What's New from Edward Valves

New Products . . . Solutions to Problems . . . Information on Steel Valves from Edward, Long-Time Pioneer in the Field!

HOW TO SELECT CAST STEEL VALVES

Valves for today's high-pressure processes require economy, dependability and safety in operation. The material on these pages is designed to help acquaint you with a few basic principles and features you should consider when selecting cast steel valves 2½ inches and larger.

VALVE FEATURES FOR LONGER LIFE, EASIER OPERATION

Valve Handwheel should be large enough to operate valve easily. On smaller valve sizes, a knobbed handwheel design permits tighter grip. But for larger, high-pressure valves, impact-type handwheels will increase closing force, insure tighter closure (see large illustration opposite page). Quick closing can be obtained with impact-type handwheels geared for closing with the aid of portable air or electric wrenches (bottom-left, opposite page). Or, where central or automatic control is desired, consider fixed motor operation (bottom-right, opposite page).

Yoke Bushing on larger valves in higher pressure classes should be equipped with double ball-bearing construction for reduced operating torque and effective transmission of closing load (large illustration on opposite page shows this design). Material is important, too. On smaller valves, bushings of bronze will help prevent stem seizing or galling. Look for ample thread engagement between bushing and yoke and between bushing and stem.

Packing Chamber should be large enough to insure long packing life. Valve packing must allow the stem to move within the bonnet but must not allow any fluid leaks between them. Well made packing, formed specifically for the packing chamber and correctly compounded for your pressure-temperature service conditions, has much to do with satisfactory valve performance. Valves with a positive backseat for re-packing while under pressure offer additional operating advantages.

Bonnet Joint of bolted construction (see Fig. 618 this page) is easiest to work with on medium or small size valves. But for lasting bonnet joint tightness, in high-temperature services (and for reduced size and weight), pressure-seal bonnet joint design is best—no flanges or bolting to periodically restress (see large illustration opposite page). Not all pressure-seal designs are alike, however. Avoid gaskets with small sealing surfaces and sharp edges that can be easily damaged and large threaded gasket loading mechanisms that are hard to disassemble and give unknown gasket compression.

Disk Guiding that properly centers the disk into the seat for positive shut-off regardless of position is important. Valve bodies with integrally cast guide ribs supporting disk throughout travel are best. Avoid designs which attempt to guide by installing spider in seat opening.

Seat-Disk Joint—An integral hard-faced seat is generally regarded as superior to screwed seat construction because it eliminates body-seat leakage and retains hardness under temperature. A hard-faced disk or disk of special alloy is desirable in high temperature services; but 13 per cent chromium stainless steel is an excellent all purpose material below 750° F.

Body Design with streamlined flow passage areas (opposite page) reduces wear-producing turbulence, decreases pressure drop and delivers maximum flow. Valves with streamlined body contours will often permit the use of smaller pipe and valve sizes. Angle valves (see Fig. 7517Y, upper right) have even less pressure drop.

For more detailed information, contact your Edward Representative, or write Edward Valves, Inc., 1230 West 145th Street, East Chicago, Indiana. Subsidiary of Rockwell Manufacturing Company. Represented in Canada by Lytle Engineering Specialties, Ltd., 360 Notre Dame Street, W., Montreal 1, Quebec.

Edward Valves builds a complete line of cast steel stop, check, non-return, stop-check and gate valves for pressures to 10,000 lbs. available with flanged or welding ends. Below are illustrated a few of the major valve designs from this complete line.

Fig. 7517Y
Angle stop valve, 1500 lb at 850 F. (3600 lb WOG), with integral Stellite seat, Stellited disk, pressure-seal bonnet, welding ends. 2½" to 14".

Fig. 618
Globe stop valve, 600 lb at 850 F. (1440 lb WOG), bolted bonnet, flanged ends, integral Stellite seat, Stellited disk. Sizes 2½" to 6".

Fig. 607Y
Angle non-return valve, 600 lb at 850 F. (1400 lb WOG), with pressure-seal bonnet, integral Stellite seat, Stellited disk-piston, welding ends, sizes 8" to 14".

Fig. 611—Gate valve, 600 lb at 850 F. (1440 lb WOG), with hard-surfaced seats and wedge, ball bearing yoke, flanged ends. Sizes 2½" to 12".

Fig. 4094Y—Horizontal check valve, 900 lb at 850 F. (2160 lb WOG), with integral Stellite seat, Stellited disk-piston, pressure-seal cover, welding ends. Sizes 2½" to 14".

Fig. 7514—Flite-Flow globe stop valve, 1500 lb at 850 F. (3600 lb WOG) or 2500 lb at 850 F. (6000 lb WOG), with extremely low pressure drop and other premium features. Sizes 10" to 18".

EDWARD STEEL VALVES
another fine product by
ROCKWELL

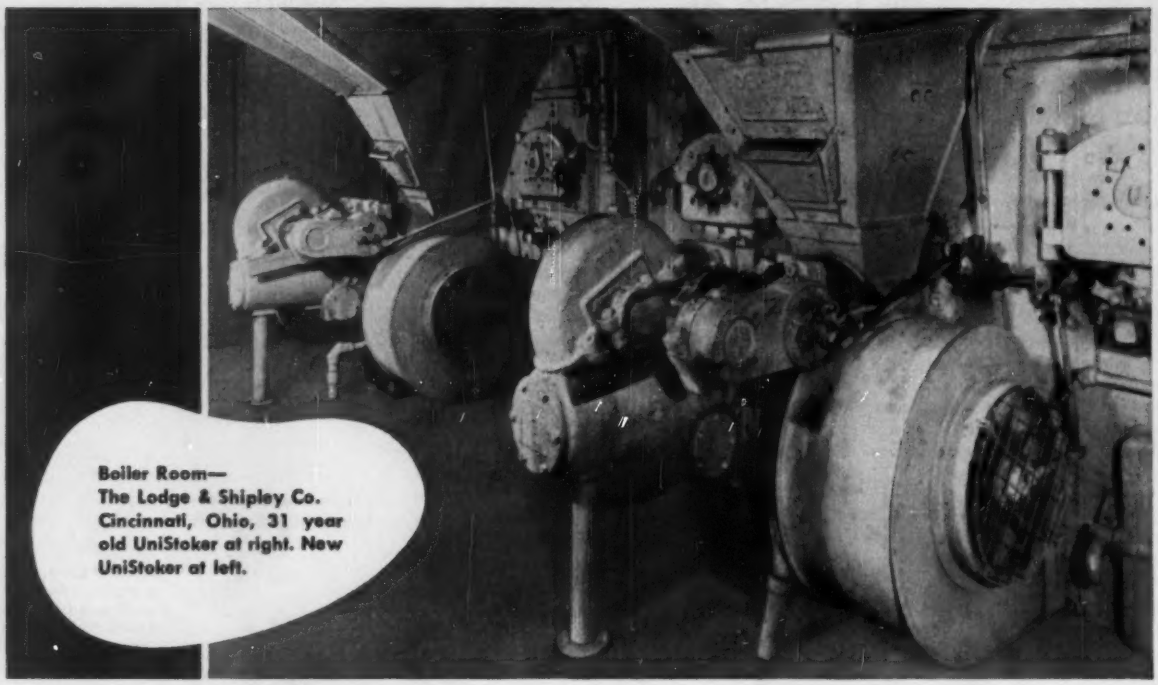
Catalog 14 contains full data on the complete Edward line of forged and cast steel valves from ¼" to 18"; in globe and angle stop, gate, non-return, check, blow-off, stop-check, relief, hydraulic, instrument, gage and special designs; for pressures up to 10,000 lbs. with pressure-seal, bolted, union or welded bonnets, with screwed, welding or flanged ends.

For more facts circle 219 on Reader Service card, p 117

UNI-STOKERS NEVER DIE, NEVER DIE

THEY JUST GO ON... AND ON*

31 Year old Detroit UniStoker is still serving and saving



Boiler Room—
The Lodge & Shipley Co.
Cincinnati, Ohio, 31 year old UniStoker at right. New UniStoker at left.

● A Detroit UniStoker installed at The Lodge & Shipley Co., Cincinnati in 1927 performed so well and proved the economy of UniStoker firing so conclusively that another UniStoker was purchased in 1958 when added steam capacity was needed to serve plant expansion.

EVEN MORE SIGNIFICANT—the original UniStoker after 31 years of service was doing such a good job it was deemed worthy of modernization.

Some of the up-to-date UniStoker features were added to it and many more years of efficient operation are expected.

As the song says—"They just go on and on", saving as they go.

YOU can save with Detroit Stokers. Let one of our sales Engineers recommend the correct stoker for your needs.

The Complete Detroit Line of Underfeed and Overthrow Spreader Stokers provides a type and size for almost any boiler from 3,000 to 400,000 pounds of steam per hour capacity.

8227

Write **DETROIT STOKER COMPANY**

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District Offices or Representatives in Principal Cities

New from American-Standard
Industrial Division

Power-Lift† for Power Plants

Power-Lift is a timely new concept of coordinated products and services from American-Standard Industrial Division. Its purpose is to help you raise overall efficiency in your plant by offering *products* that are proved in the field and designed, engineered, and manufactured to a uniform standard of quality and performance . . . with *service* by product specialists in every principal city.

To see how Power-Lift services can benefit you . . .

← LIFT THE FLAP

† Service-mark of American-Standard

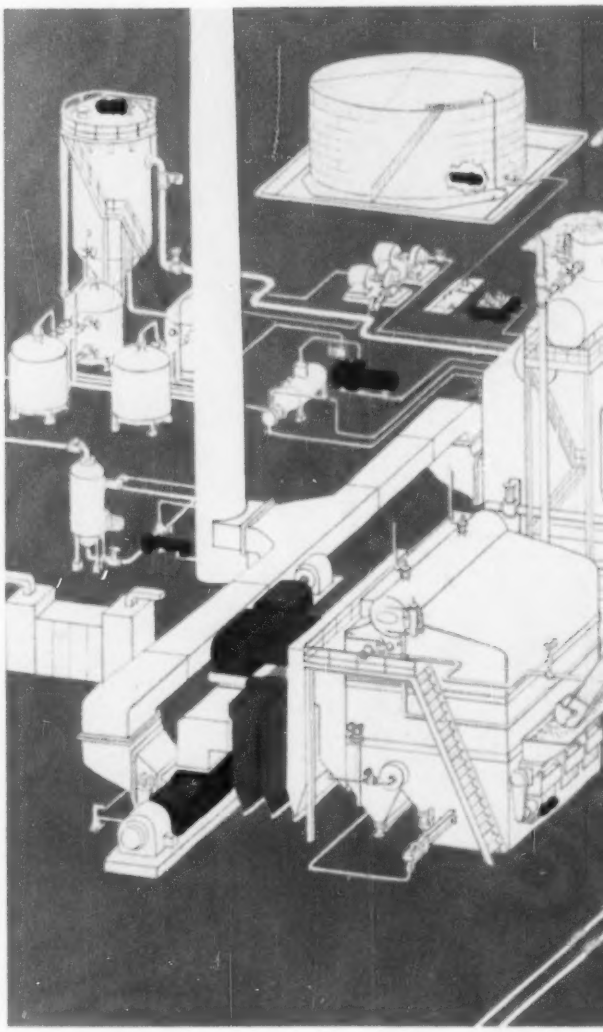
American-Standard Industrial Division **POWER-LIFT IN ACTION**

1959

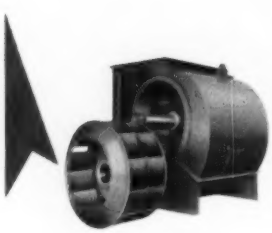
Early in 1959 three American-Standard divisions—American Blower, Ross Heat Exchanger, and Kewanee Boiler—were combined into a single organization under a new name: American-Standard Industrial Division. The year 1959 was spent fruitfully—consolidating product lines, accelerating new product development, gearing up to meet the stepped-up requirements of the fast-paced, highly specialized power industry.

1960

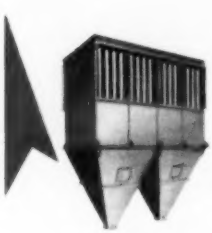
Today, we're confident that you'll find new benefits in specifying products from American-Standard Industrial Division . . . products that now encompass the major fields of heat transfer, mechanical draft, boiler feed pump and fan control, fly ash and dust control, heating, ventilating, and air conditioning. The illustration at right shows where many of these products may be applied in a modern steam plant. Each is designed, engineered, and manufactured to help you produce power efficiently and economically. Each is backed by an honestly won reputation for reliability on the job.



Here's where some



Mechanical Draft Fans



Dust and Fly Ash Collectors

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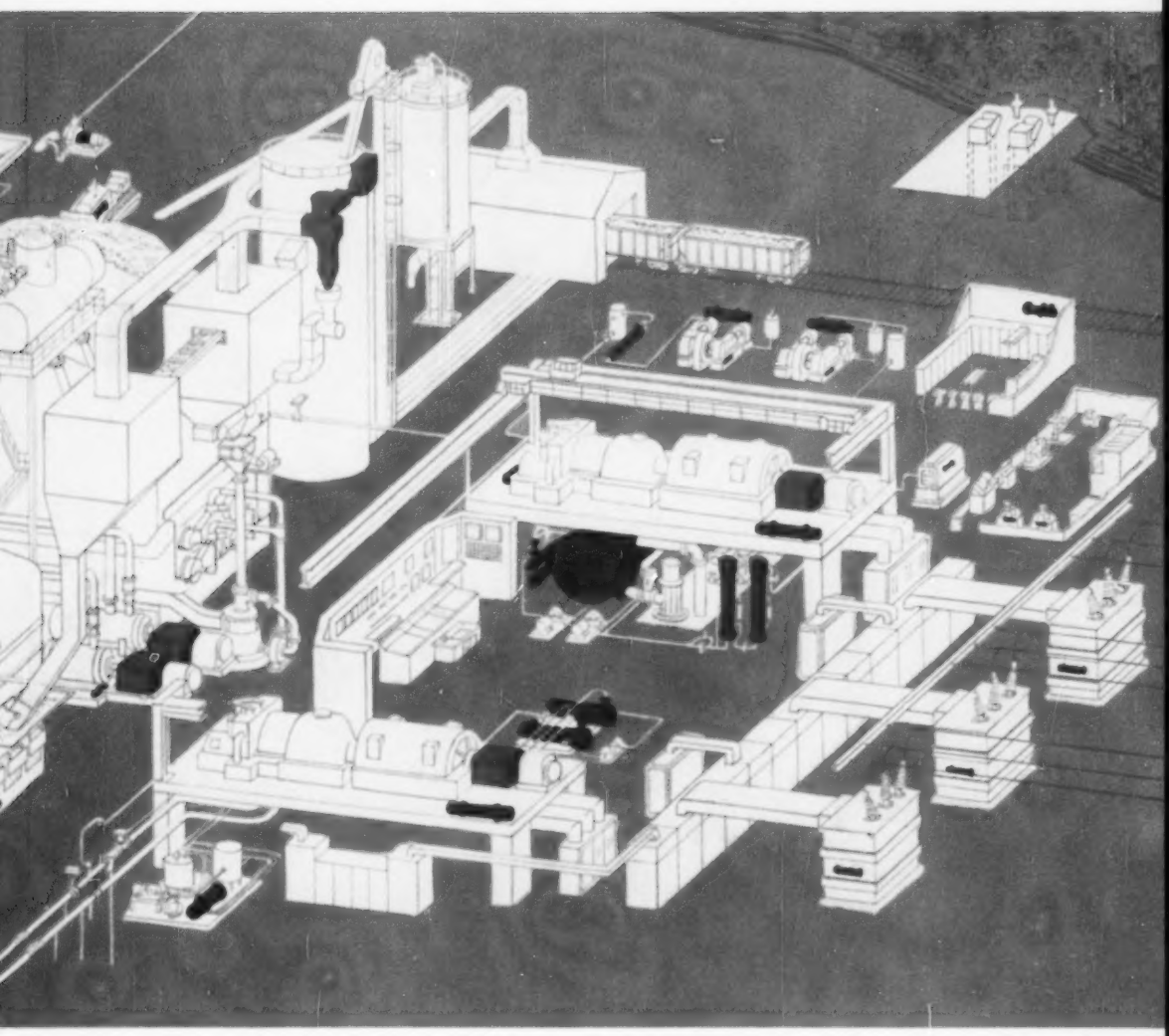
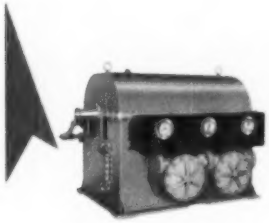
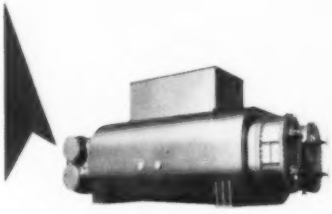


some of American-Standard Industrial Division products serve in a modern power plant.



Gyrols Fluid Drives for fan and feed pump control



Surface Condensers and Feedwater Heaters

Heat Exchangers and After Coolers

As Near as Your Phone

American-Standard Industrial Division
Power-Lift Products and Services

Talk over your requirements with an American-Standard* Industrial Division product specialist. You'll find him well prepared and experienced—frequently able to base equipment recommendations upon precedents of proved success. And, in many instances, our comprehensive standardization paves the way to savings in time and cost. Offices in all principal cities. AMERICAN-STANDARD INDUSTRIAL DIVISION, DETROIT 32, MICHIGAN. IN CANADA: AMERICAN-STANDARD PRODUCTS (CANADA) LIMITED, TORONTO, ONTARIO. EXPORT DIVISION, AMERICAN-STANDARD, NEW YORK CITY.

SURFACE CONDENSERS

Designed to service the largest of today's and tomorrow's steam turbines. Low bundle entrance velocity; liberal steam transportation lanes; moisture impingement grids to extend tube life; expansion diaphragms; effective de-aeration and many other features created during 40 years of surface condenser development and research.

MECHANICAL DRAFT FANS

Complete range of sizes and types for forced draft, induced draft, gas recirculating, and primary air fan applications. Designed to meet rigid requirements of modern power plants where maximum pounds of steam are produced daily at peak efficiency. Airfoil, forward curved, backwardly inclined, radial, radial tip blades.

FEEDWATER HEATERS

Design incorporates unique new High Pressure closure. Maintenance is simplified with only four major parts. Exceptionally high safety factor built into all units—more than double ASME Code requirements. Temperature stresses from start-ups or load changes virtually non-existent.

HEAT EXCHANGERS

Designed and built with thoroughness and precision. Standard or specially engineered units for virtually all conditions and applications, including high pressure-high temperature exchangers, compressor inter- and after-coolers, fuel oil heaters, blow-down exchangers, and many others.

GYROL® FLUID DRIVE

Provides stepless adjustable speed control for fans and boiler feed pumps. Performance, power savings, and reliability proved in the field. Units for motor driven boiler feed pumps or for "on-the-shaft" duty on main turbine generator. Drives are available for fan and pump duties for all boiler sizes.

DUST AND FLY ASH COLLECTORS

Type "D" Dust Collector: mechanical "cyclone-type" collector. Series 342 Dust Collector: uses "cyclone" principle, with individual tubes which permit flexibility in design to fit plant layout. Series 361 Dust Collector: combines primary and secondary systems for high efficiency fly ash recovery.

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AMERICAN-Standard PRODUCTS

AMERICAN-Standard
INDUSTRIAL DIVISION

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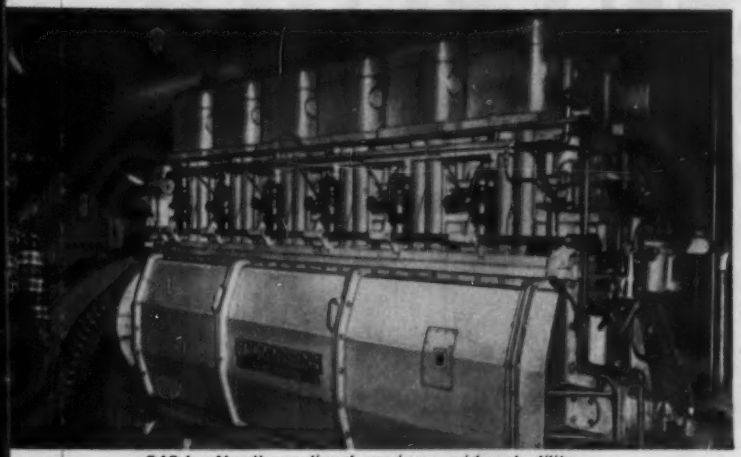
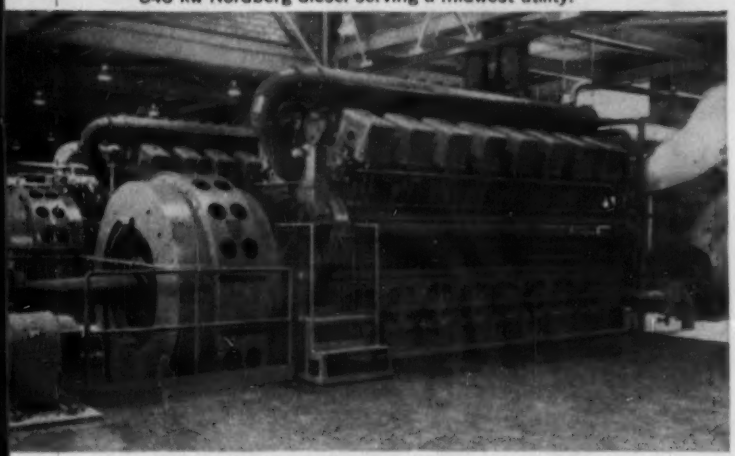
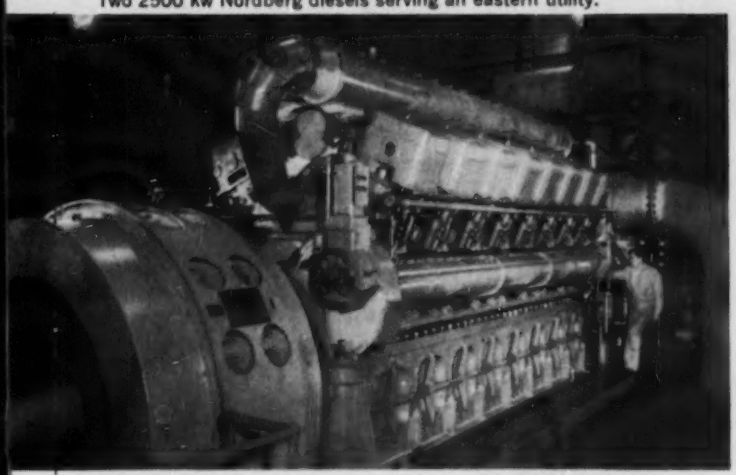
Cut power costs with NORDBERG ENGINES



840 kw Nordberg diesel serving a midwest utility.



Two 2500 kw Nordberg diesels serving an eastern utility.



2285 kw Nordberg diesel, one of three in a southern utility.

FOR STANDBY SERVICE

If lack of sufficient power makes it difficult to hold generating costs "down," and standby reserve "up," it will pay you to investigate the advantages of Nordberg engines. These efficient prime movers are easily installed independent of existing power facilities, go on the line quickly, and generate low cost power under all load conditions.

FOR PEAK LOAD SERVICE

If your base generating station is having difficulty "topping the load" at an economical figure, follow the example of many utilities who have assigned peaking problems to Nordberg engines . . . and in doing so have also added desirable generating flexibility and standby protection while amortizing their investment through more profitable operation.

FOR BOOSTING VOLTAGE

If your load has grown beyond the capacity of the existing transmission system and if there is difficulty maintaining voltage in outlying areas, Nordberg engines can give you the increased capacity at low cost per kwh. These efficient units are easily installed, and can be readily tied into the line at strategic locations to boost the voltage.

We will welcome your inquiry and the opportunity to discuss the advantages of Nordberg engines for your specific power requirements. Write for further details.

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NORDBERG MANUFACTURING COMPANY • Milwaukee 1, Wisconsin

ATLANTA • CLEVELAND • DALLAS • DULUTH • HOUSTON • KANSAS CITY • MINNEAPOLIS • NEW ORLEANS • NEW YORK • ST. LOUIS
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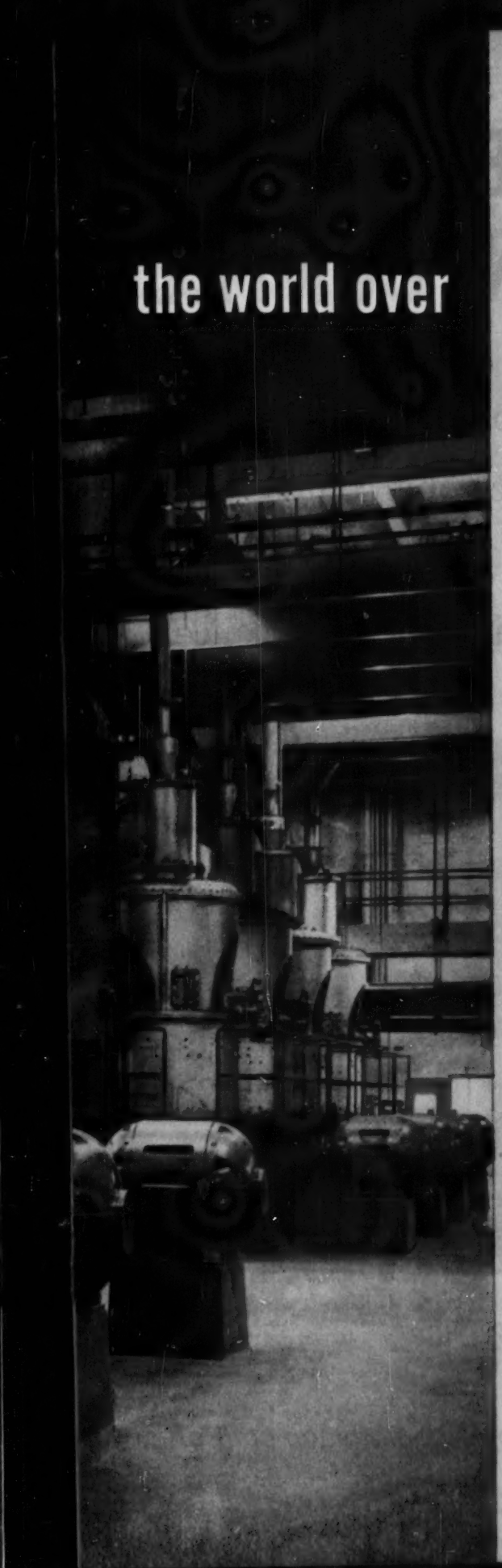
BOWL MILLS LIKE THESE

prepare the daily BTU diets of boilers



the world over

C-E RAYMOND BOWL MILLS pulverize lignite in Mallorca, Spain ... coke in Buenos Aires ... semi-bituminous coal in Limburg, Holland ... bituminous in Tanagawa, Japan ... furfural residue in Tennessee ... and petroleum coke in Indiana. But their biggest field of application, by far, is pulverizing various kinds of coal in hundreds of American utility plants from coast to coast. In all, they feed the boilers of the world with some 37,000 tons of fuel each hour — boilers with an aggregate steam generating capacity of about ...

400,000,000 lb. per hr.

There are eight big reasons why the C-E Raymond Bowl Mill is so popular — reasons that are important to you if pulverized fuel is part of your plant picture. They are ...

1. **Handles High Moisture Fuels** — High moisture fuels are handled without difficulty because the Bowl Mill premixes raw coal with the dried product in an atmosphere up to 700 F air. Even lignite with 50% moisture is thoroughly dried.
2. **Low Power Consumption** — Rapid flow of material through the mill, prompt removal of fine coal, fast drying and relatively low weight of grinding elements all combine to assure minimum power consumption.
3. **Continuous Service** — The Bowl Mill provides continuous service for long periods because there is no metal-to-metal contact between rings and rolls and wear is minimized. Logs showing 20,000 hours of continuous operation are not uncommon.
4. **Low Maintenance** — Maintenance is required less frequently because the Bowl Mill stays in service for longer periods. When replacement of parts is necessary, outage time is minimized because of the ease with which the machine can be taken apart and reassembled.
5. **Fineness Control** — Changes in fineness control can be made while the Bowl Mill is operating because the necessary adjustments are made from the outside. The mill need not be stopped.
6. **Automatic Grinding Adjustment** — Grinding pressure is automatically adjusted to suit fuel characteristics because the Bowl Mill uses spring-loaded journals which instantaneously compensate for variations in coal grindability.
7. **Infrequent Lubrication** — Only infrequent lubrication is required with the Bowl Mill. When required, it can be done from outside the mill without taking it out of service.
8. **Vibrationless-Quiet** — The Bowl Mill's grinding rollers make no metal-to-metal contact with the grinding ring, assuring quiet, vibrationless operation.

Whether you are considering pulverizers for your present plant expansion program or for future requirements, we suggest you investigate the advantages of the Bowl Mill as outlined above and described more fully in our Catalog PC-8.

COMBUSTION ENGINEERING

C-E

C-229

200 Madison Avenue, New York 16, N. Y.

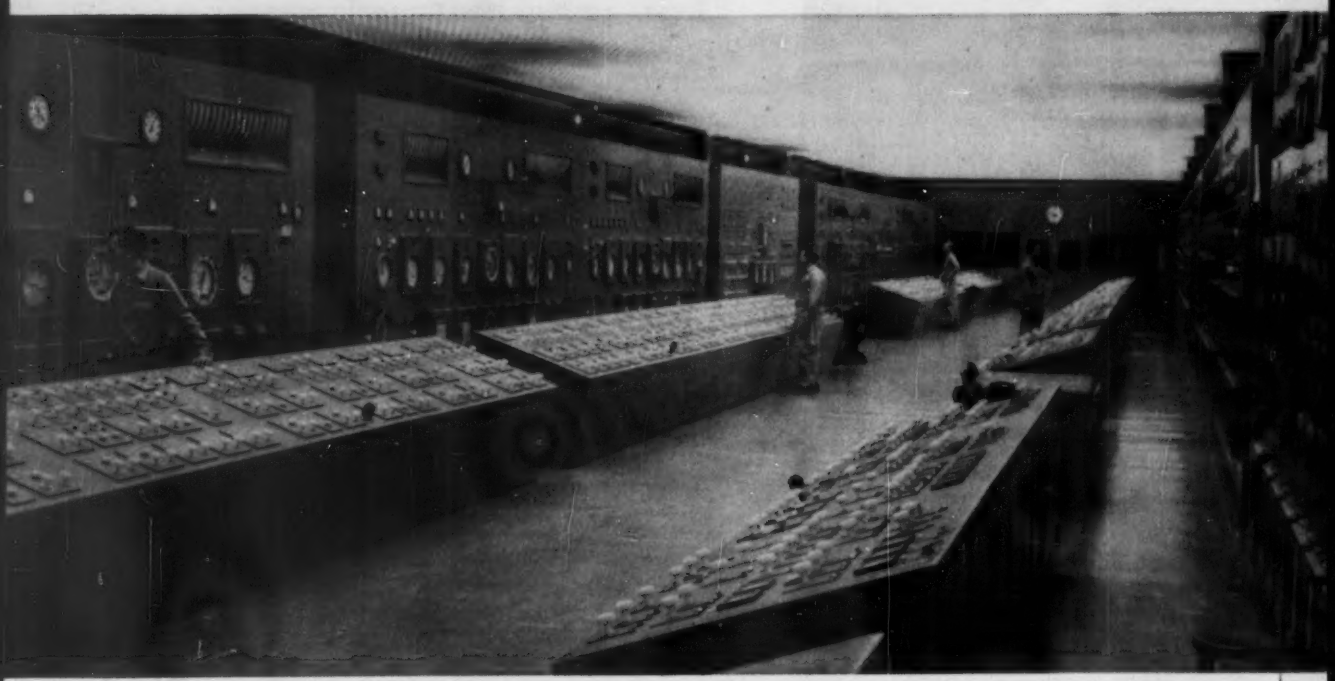
Combustion Engineering Building

ALL TYPES OF STEAM GENERATING, FUEL BURNING AND RELATED EQUIPMENT; NUCLEAR REACTORS; PAPER MILL EQUIPMENT; PULVERIZERS; FLASH DRYING SYSTEMS; PRESSURE VESSELS; SOIL PIPE

For more facts circle 223 on Reader Service card, p 117

WHAT REPUBLIC'S TEN COMBUSTION CONTROL

In the last ten years, Republic Flow Meters has designed over 125 electronic combustion control systems for steam generating plants. Republic has over 400 unit-years experience

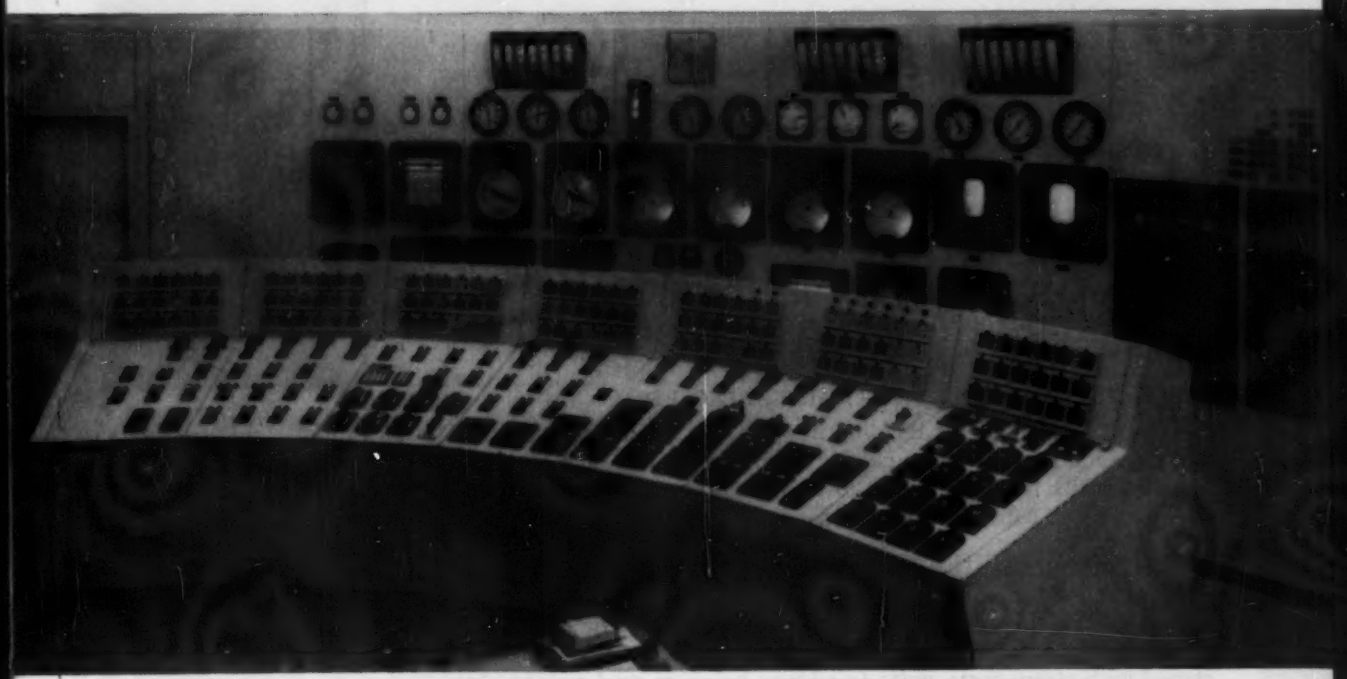


1949—The first electronic combustion control system was designed by Republic and installed at Commonwealth Edison's 640,000 KW Ridgeland Station near Chicago. To maintain maximum firing efficiency, 28 cyclone furnaces are individually controlled and integrated with over-all plant operation by a Republic Electronic Combustion Control System.

Leading manufacturer of electronic combustion control

YEARS OF ELECTRONIC LEADERSHIP MEANS TO YOU

with electronic combustion control installations ready to go to work on your system. This is engineering know-how you get only from Republic Flow Meters.



1959—This Republic Electronic Control System, one of the most recent to be put into service, is for 121,000 KW, unit No. 1 at the Paul L. Bartow Station of Florida Power Corporation, St. Petersburg, Florida. It controls a 900,000 lb/hr oil and natural gas boiler. Republic is currently engineering an electronic control system for unit No. 2 in this plant.

REPUBLIC FLOW METERS COMPANY
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REPUBLIC INSTRUMENTS AND CONTROLS
more fine products by
ROCKWELL

For more facts circle 224 on Reader Service card, p 117

Coal cuts fuel costs $5200 a year

Hinsdale High School uses just 1450 tons of coal a year, saves on fuel and handling costs

When Hinsdale Township High School, Hinsdale, Ill., was designed, an engineering survey on the cost of steam generation was conducted simultaneously. (Steam would be used principally for heat, hot water, swimming pool and laundry.) The survey dictated the selection of coal for lowest fuel costs and a completely modern coal-fired plant was designed for maximum efficiency and economy. Today, outstanding features of this coal burning plant are: one-man operation, economy in labor and fuel, mechanical coal and ash handling and low maintenance costs. The decision to use coal saves this relatively small coal-burning plant $5200 in fuel costs annually over the nearest competitive fuel.

COAL IS LOWEST COST FUEL

Today, *when the annual cost of fuel often equals the original cost of the boilers,* you should know that bituminous coal is the lowest cost fuel in most industrial areas. And modern coal-burning equipment gives you 15% to 50% more steam per dollar, while automatic operation trims labor costs and eliminates smoke problems. What's more, tremendous coal reserves and mechanized mining procedures assure you a constantly plentiful supply of coal at stable prices.

CONSULT AN ENGINEERING FIRM

If you are remodeling or building new heating or power facilities, it will pay you to consult a qualified engineering firm. Such concerns —familiar with the latest in fuel costs and equipment—can effect great savings for you with the efficiency and economy of coal.

TECHNICAL ADVISORY SERVICE

To help you with fuel problems, the Bituminous Coal Institute offers a free technical advisory service. We welcome the opportunity to work with you, your consulting engineers and architects. If you are concerned with steam costs, write to address below or send coupon. Ask also for case histories booklet, complete with data sheets. You'll find them informative.

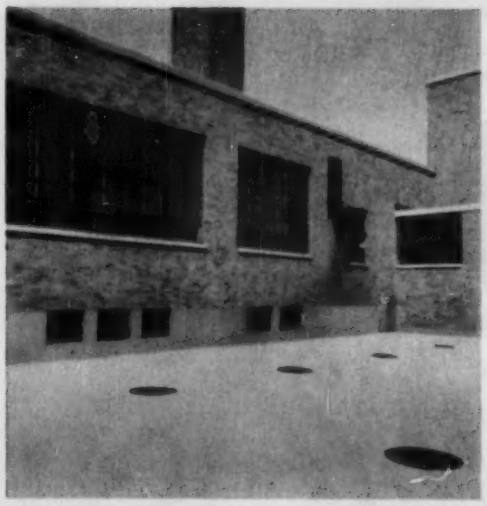
BITUMINOUS COAL INSTITUTE

Department P-02, Southern Building, Washington 5, D. C.

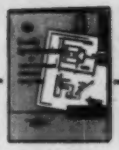
See our listing in Sweet's Files: A-30J/Bi; PE-4a/Bi; IC-18/Bi

Three boilers in foreground are Kewanee Type C firebox units, rated at 20,000 sq. ft. radiation, fired by Iron Fireman single-retort stokers, with 1000 lb/hr coal feeding capacity. At rear is Fitzgibbons Type D firebox unit rated at 29,000 sq. ft. fired by Iron Fireman stoker, 1200 lb/hr capacity.

Exterior view of power plant. Coal is gravity fed from trucks through manholes into 600-ton storage bin. It is then moved by Hager screw conveyor to stokers. Ashes move from ash room by Webster bucket conveyor to chute (on right) for disposal.



SEND COUPON FOR NEW BCI PUBLICATIONS
Guide Specifications, with complete equipment criteria and boiler room plans:



P-62

Bituminous Coal Institute
Southern Building, Washington 5, D. C.

Gentlemen: Please send me:

- ☐ GS-1 (low-pressure heating plant, screw-type underfeed stoker).
- ☐ GS-2 (high-pressure heating and/or process plant, ram-type underfeed stoker).
- ☐ GS-3 (automatic package boiler for heating and process plants).
- ☐ Case histories on larger plants.

Name_____

Title_____

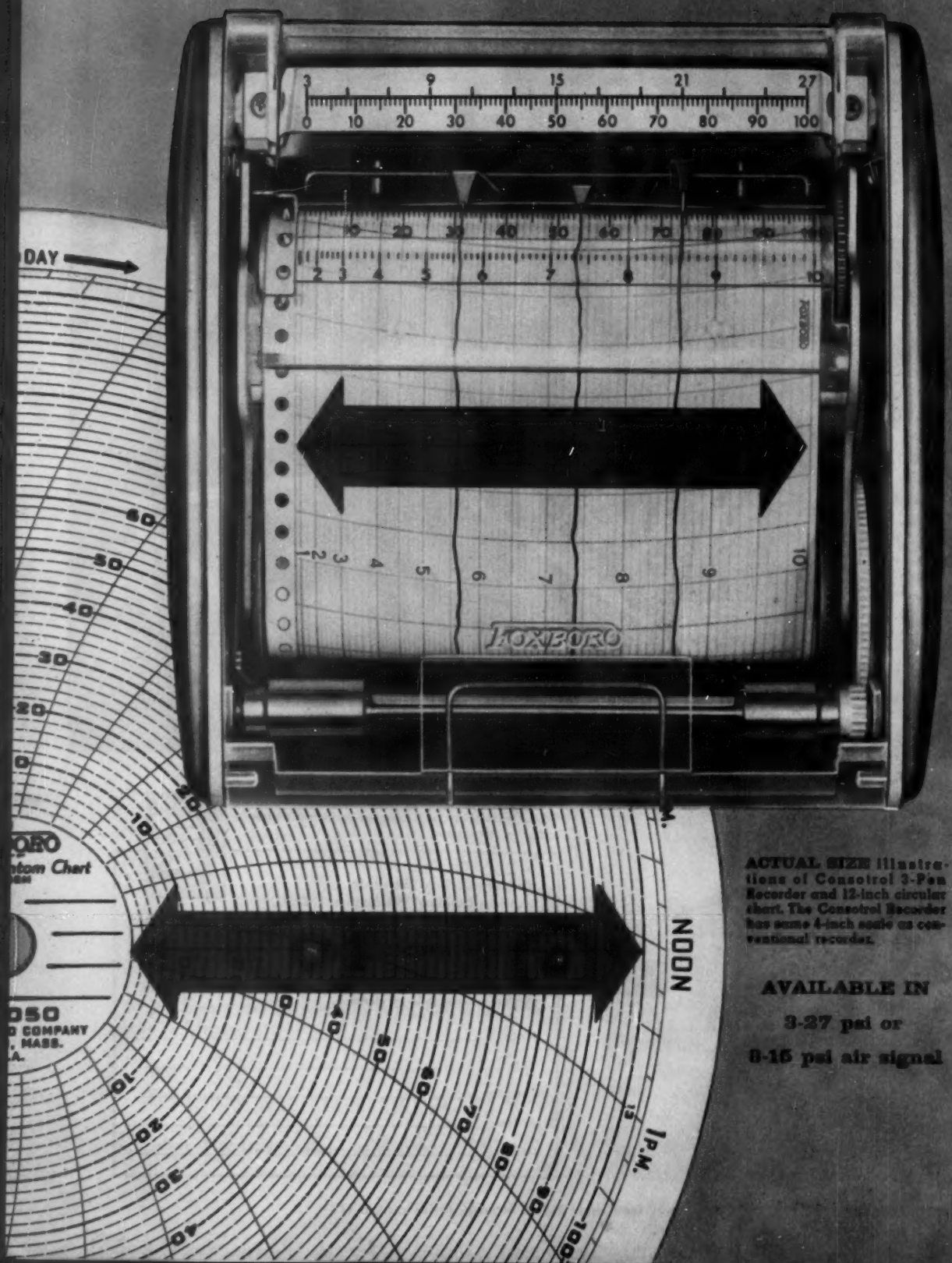
Company_____

Address_____

City_____ Zone____ State_____

For more facts circle 225 on Reader Service card, p 117

FOXBORO "small-case"



ACTUAL SIZE illustrations of Consotrol 3-Pen Recorder and 12-inch circular chart. The Consotrol Recorder has same 4-inch scale as conventional recorder.

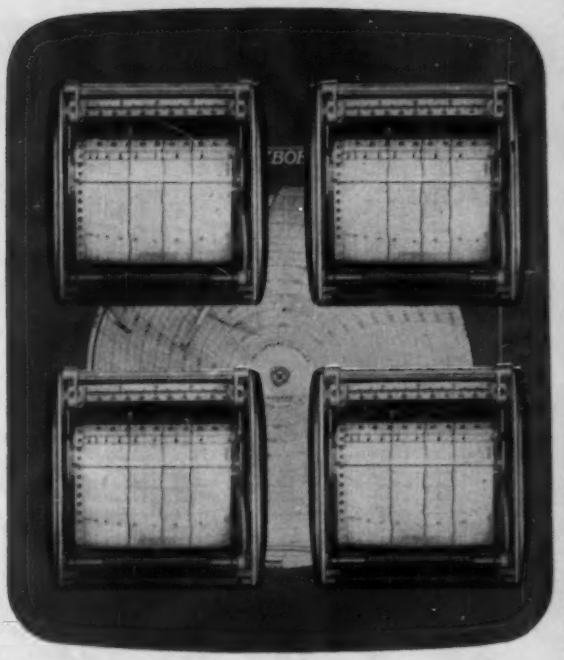
AVAILABLE IN

3-27 psi or

6-15 psi air signal

Recorders save 75% in panel space...

...without sacrifice of FULL-SCALE readability



FOUR WHERE ONE USED TO GO — providing up to 12 full-size, continuous records.

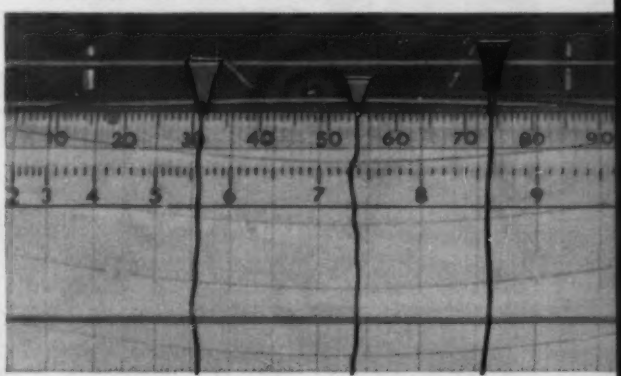
Think of it! Four compact Consotrol* Recorders actually occupy less panel space than one conventional size recorder. Yet there's no sacrifice in readability, for Consotrol charts have the same length scale as standard 12" recorders.

And 75% panel space savings are only the beginning. Consotrol Recorders are now available in 3 - 27 psi models, (as well as 3 - 15 psi) for greater flexibility in power plant trend-recording.

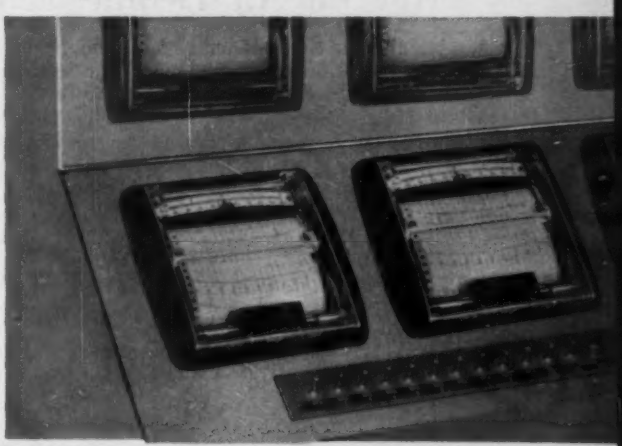
They're simple to maintain, too. On all recorders (one, two, or three pen), all calibration adjustments are made from the front; charts replaced at 30-day intervals; re-inking done just twice a year. Accurate and dependable, Consotrol Recorders are ideal for recording trends of boiler feed water, steam-air and fuel-air flows, as well as steam pressure, temperature and other variables.

Get complete details on Consotrol "small-case" Recorders. Write for Bulletin 13-18A. **The Foxboro Company, 682 Neponset Ave., Foxboro, Mass.**

*Reg. U. S. Pat. Off.



3-PEN RECORDING — 3 continuous records can be simultaneously recorded on one Consotrol chart. Related measurements can be grouped for quick comparison — valuable panel space saved.



ANGLE MOUNTING — One- and two-pen Consotrol Recorders may be panel-mounted as much as 75° from the vertical. A whole "extra" row of instruments can be read without stooping.

FOXBORO

REG. U.S PAT. OFF.

CONSOTROL RECORDERS

For more facts circle 226 on Reader Service card, p 117

AI's extensive field laboratory is located in California's Santa Susana Mountains. *Woodcut by Edward Kysar.*

How can A.I. facilities help you plan a Nuclear Program?

In the picturesque Santa Susana mountains near Los Angeles, Atomics International has built an extensive field laboratory for research, engineering and testing in the nuclear sciences. Here, and at a headquarters complex in the valley below, men who pioneered the creative uses of atomic energy are applying their experience to develop advanced nuclear reactors and associated equipment.

Fourteen years of experience in developing various types of reactors for the Atomic Energy Commission and other organizations have given the men of Atomics International a collective background unparalleled in the industry. The facilities at their disposal are among the most sophisticated and extensive in the world.

Results of AI's work have been demonstrated in projects for the AEC which include the Organic Moderated Reactor Experiment at the National Reactor Testing Station in Idaho and the Sodium Reactor Experiment at the company's field laboratory. Additionally, AI built and is operating SNAP II, a 220 pound prototype reactor to produce three kilowatts of electricity for space vehicles.

Atomics International is also building large power reactors for electric utilities in Ohio and Nebraska under AEC programs. Studies are underway for other power reactors in the United States and Europe. Research reactors have been built by AI for Denmark, Germany, Italy, Japan, Puerto Rico and several sites in the United States.

For details contact: ATOMICS INTERNATIONAL, Canoga Park, California, U.S.A. Cable address: ATOMICS.

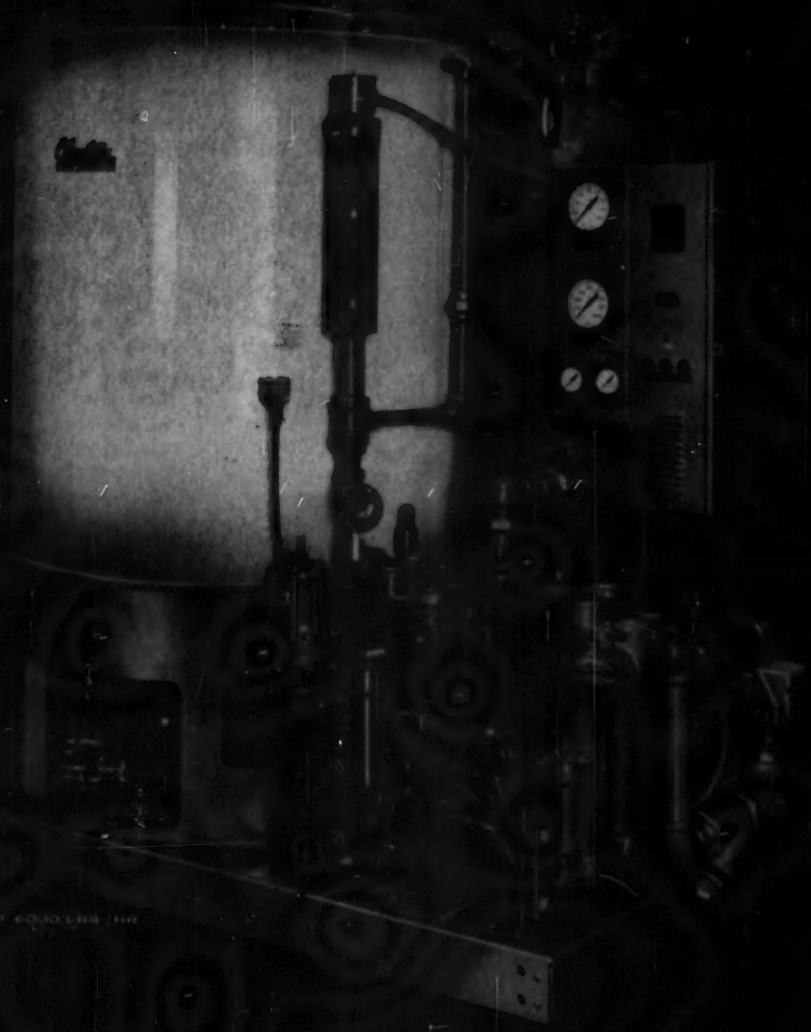
ATOMICS INTERNATIONAL

A DIVISION OF NORTH AMERICAN AVIATION, INC.

PIONEERS IN THE CREATIVE USE OF THE ATOM

Other offices in: Washington, D.C., U.S.A.; Geneva, Switzerland. Affiliated with: INTERATOM, Bensberg/Cologne, Federal Republic of Germany and DYNATOM, Paris, France.

STEAM THE MODERN WAY



CLAYTON STEAM GENERATORS

Up in performance—Down in size

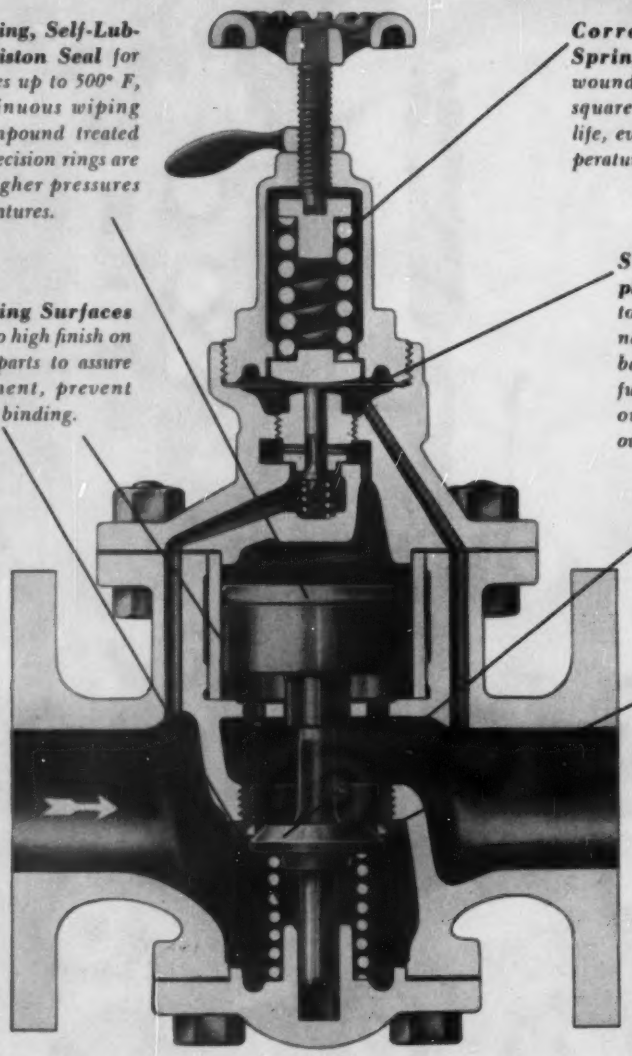
Clayton

MANUFACTURING

HERE'S WHY YOU GET EXTRA VALUE IN LESLIE'S COMPLETE LINE OF

Self-Cleaning, Self-Lubricating Piston Seal *for temperatures up to 500° F, gives continuous wiping action. Compound treated cast iron precision rings are used for higher pressures and temperatures.*

Long Guiding Surfaces *are ground to high finish on all moving parts to assure true alignment, prevent cocking and binding.*



Corrosion-Resistant Springs *are accurately wound with ends ground square. Maximum spring life, even under high temperature conditions.*

Stainless Steel Diaphragm *responds instantly to any flow change—eliminates stuffing boxes and bellows seals. Diaphragm's full travel is less than its own thickness, can't be over-stressed.*

Single Seated Construction *assures positive dead end shut off.*

Stellited Seating Surface *combined with a hardened stainless main valve provides ultimate in erosion resistance.*

Interchangeable parts *May be replaced without taking valve body off the line, and, even more important, without machining.*

Cutaway of Leslie internal pilot, piston operated reducing valve class LY, shows typical Leslie quality construction features. Throughout the Leslie line, features like these and others presented on the next page are your assurance of lower operating costs and long life performance. They are based on over 50 years of leadership in designing and manufacturing quality regulators.

Internal pilot piston operated reducing valves are available for steam services, up to 2500 lbs., ASA, reduced pressure ranges to 1400 psi. Sizes ½ to 6". Cast iron, bronze, steel or alloy steel construction.

IN LESLIE'S REDUCING VALVES AND REGULATORS

LESLIE SMALL FLOW REDUCING VALVES

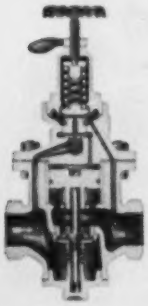
Leslie small flow reducing valves are used in pilot plant operations, plastic molding presses, laboratory units, gland sealing, steam sterilization and atomizer units and wherever control of small flows of steam, air, gas or non-corrosive liquids are a problem.

These ½" valves feature simple, direct operated design with screwed or bolted adjusting spring assembly for easy access to the internal parts. No stuffing boxes or fussy seals.

PRESSURE-TEMPERATURE RANGES

BODY MATERIALS AND CONSTRUCTION	CLASS	MAX. INLET PRESSURE PSI		MAX. TEMP. °F.	MIN. PRESS. DROP PSI	REDUCED PRESS. RANGE PSI
		STEAM	COLD LIQUID AIR OR GAS			
BRONZE Screwed Bonnet	LCA	–	400	150	10	5-285
	LCB LCC LCD	300	400	550	10	10-285
	LCLA	–	400	150	10	2-35
	LCLB LCLC LCLD	300	400	550	10	2-35
STEEL Thru-bolted Bonnet	LCL(B)S LCL(C)S LCL(D)S	600	1000	750	10	25-400 10-50

LESLIE REDUCING VALVES FOR AIR OR GAS SERVICE



Leslie internal pilot, piston operated reducing valves offer a combination of accurate regulation and low maintenance service, and are used for accurate control of air or gas with inlet pressures up to 400 psi at 150° F.

Accuracy of regulation is comparable to instrument control with full flow for equivalent pipe size. Valves feature 99% accuracy of regulation at rated capacity.

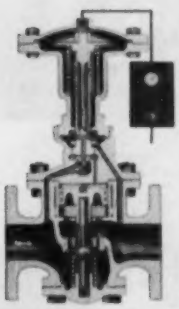
Positive, bubble tight shut-off is provided by resilient, single seated valve disc. Fully guided main valve, stainless steel diaphragm and non-corroding internal springs assure long, trouble-free operation.

PRESSURE RANGES AND CONSTRUCTION

CLASS	SIZE (Inches)	MAXIMUM INLET PRESSURE & TEMP.	REDUCED PRESSURE RANGE-PSI		BODY MAT'L.	END CONNECTIONS
			MIN.	MAX.		
LA-5 LAE-5	½-4	25-400 psi 150° F max.	5*	285	Bronze	½-3" 300 lb. screwed ½-4", 150 & 300 lb. MSS flanged
LAK LAEK		25-400 psi 150° F			Cast Iron	½-3" 250 lb. screwed 1½-3" 250 lb. ASA flanged
		25-175 psi 150° F max.				1½-4" 125 lb. ASA flanged

*5% of inlet pressure over 100 psi

REMOTELY ADJUSTED REDUCING VALVES



Operating characteristics of Leslie remotely adjusted reducing valves are identical to manually adjusted types. The remotely adjusted reducing valve is adjusted to the desired pressure setting by air pressure from an air loading device. The constant loading force on the upper diaphragm opens the pilot valve and is balanced by a constant reduced pressure proportional to the loading force.

The air loading panel eliminates hazardous or inconvenient adjustments and provides fast means of readjusting pressure to meet changing requirements.

REMOTELY ADJUSTED REGULATING VALVES

TYPE	SIZES AVAILABLE (Inches)	BODY MATERIALS AVAILABLE	INLET PRESSURE RANGES (PSI)	MAXIMUM REDUCED PRESS. (PSI)
Small flow, internal pilot actuated, diaphragm operated	⅛, ¾, ½	Bronze	20-300 psi 550° F steam 20-400 psi 150° F air	175
Internal pilot actuated, piston operated	½ - 6	Cast Iron Bronze Cast Steel	25 psi up to 600 psi, 750° F	175
Internal pilot actuated, piston operated for high pressure service	½ - 3	Cast Steel and Alloy Steels	300 psi up to 3000 psi	700

For sizing and capacity data on this Leslie line of valves, contact your Leslie engineer or write for Bulletin 5302B.

TRADE LESLIE MARK

REGULATORS and CONTROLLERS

Leslie Co.; 317 Leslie Building, Lyndhurst, New Jersey

Over 275 Factory-Trained Engineers At Your Service—Nationwide!

For more facts circle 229 on Reader Service card, p 117

Dann Goodson, *Manager Motor-Driven Compressor Sales, The Cooper-Bessemer Corporation, explains...*

How Cooper-Bessemer's new, compact Air Compressors simplify installation and reduce costs

The DMR compressors shown here are two models of a new line of *compact, 720 rpm* machines, unmatched in reliability. With these units, Cooper-Bessemer introduces a new standard of installation economy. So highly compact, the DMR compressors are readily installed in existing space, avoiding the need for additional housing facilities. They can be located at strategic points throughout the plant to supplement existing air line services without additional feeders to help supply your production needs at minimum cost.

The new DMR units come completely equipped with integral motor-drive and intercooler... ready for operation. Their control can also be integrally mounted as shown. They are available for two-stage applications in the range of 500 to 2000 cfm and discharge pressures of 80 to 125 psi... also for single-stage and three-stage operation.

The introduction of this new line of air compressors, plus the portable tool facilities of our new subsidiary, The Rotor Tool Company, enable Cooper-Bessemer to give you full-scope service for your industrial air power needs. Call the nearby Cooper-Bessemer office or air compressor agent for Bulletin No. 94 on the new DMR line.

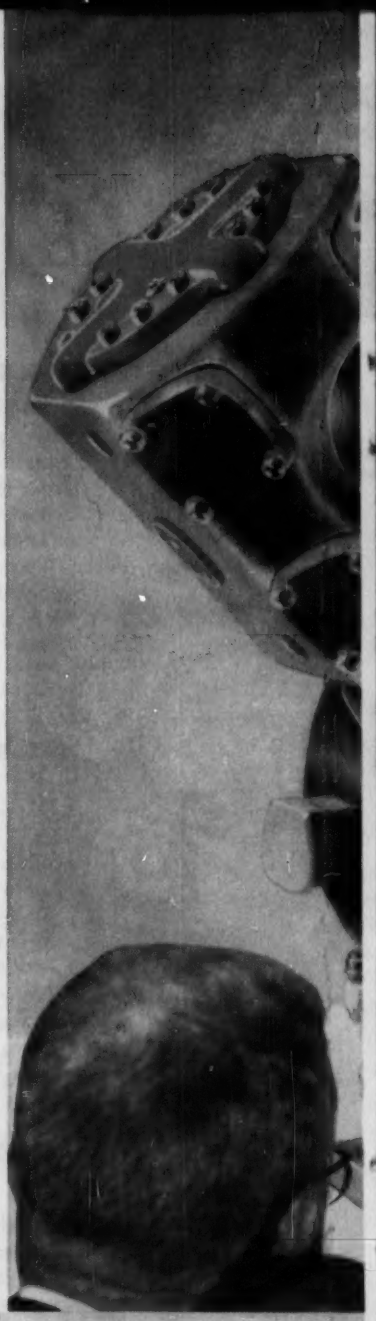
BRANCH OFFICES: Grove City • New York • Washington • Gloucester • Pittsburgh
Chicago • Minneapolis • St. Louis • Kansas City • Tulsa • New Orleans • Shreveport
Houston • Greggton • Dallas • Odessa • Pampa • Casper • Seattle • San Francisco
Los Angeles

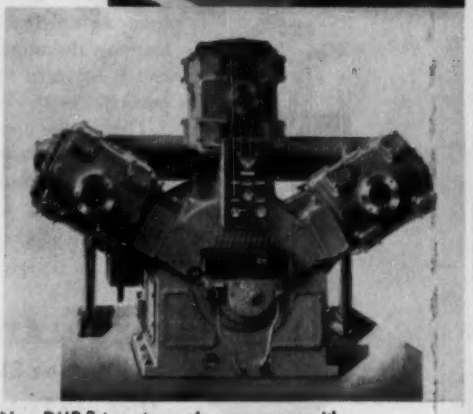
SUBSIDIARIES: Cooper-Bessemer of Canada, Ltd.... Edmonton • Calgary
Toronto • Halifax
C-B Southern, Inc.... Houston
Cooper-Bessemer International Corporation... New York • Caracas • Anaco
Cooper-Bessemer, S.A.... Chur, Switzerland • The Hague, Netherlands • Mexico City
The Rotor Tool Company... Cleveland

Cooper Bessemer

GENERAL OFFICES: MOUNT VERNON, OHIO

ENGINES: GAS • DIESEL • GAS-DIESEL
COMPRESSORS: RECIPROCATING AND CENTRIFUGAL
ENGINE, TURBINE OR MOTOR DRIVEN



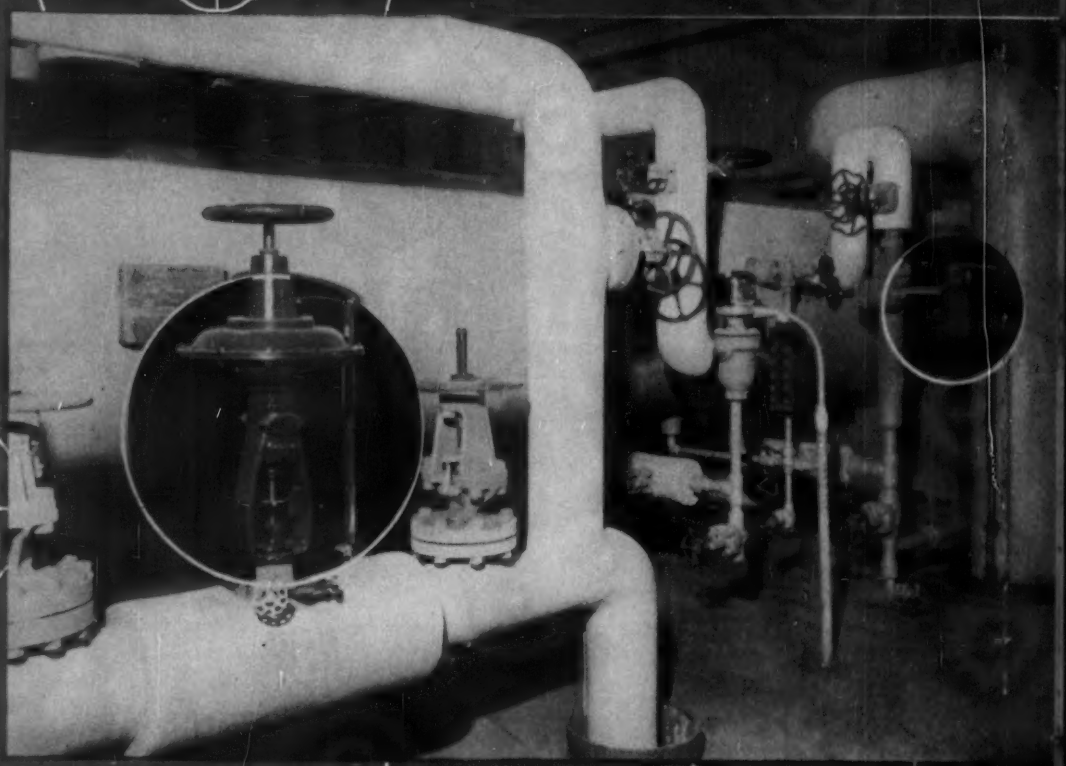


New DMR-3 two-stage air compressor with integral control. Ratings of 300-350 hp.

For more facts circle 230 on Reader Service card, p 117

NEW
COOPER-BESSEMER
DMR-2 TWO-STAGE
AIR COMPRESSOR
WITH
EN-TRONIC CONTRO
100 TO 250 HP

MASONEILAN CONTROLS PROVIDE NEEDED FOR MODERN



This is a Masoneilan Control Valve and Liquid Level Control in a modern steam-generating station at a midwestern power plant.

TYPICAL APPLICATIONS

- Feed Water Recirculating
- Desuperheater Temperature and Pressure
- Turbine Bypass, Reheat and Exhaust to Process
- Condenser and Deaerator Level
- Heater Drains
- Reducing Stations

DEPENDABILITY, FLEXIBILITY POWER PLANT ECONOMY

Masoneilan Control Valves, Liquid Level Controls and Butterfly Valves provide optimum control of temperature, pressure and liquid level to help meet today's demand for more efficient generation. Masoneilan equipment has established an outstanding record for dependability, and contributes important savings because of long service and simplified maintenance.

- **Control Valves . . .**
  Globe, angle or three-way valves designed to provide accurate, positive response to controller signal. Equipped with powerful actuators for precise plug positioning and built with maximum stamina.
- **Liquid Level Controllers . . .**
  A versatile line of controllers — designed for all types of fluid handling systems. Features include a wide selection of ranges and pressure ratings, and a variety of materials and mounting types to meet all conditions. Includes control types for special applications.
- **Butterfly Valves . . .**
  Today's most modern line of butterfly valves. Wide variety of actuators. Used for handling large volumes of water in condenser service, pump discharge or other power plant applications.

If your job involves selecting controls for fluid handling, it will pay you to get complete information on Masoneilan equipment. For free literature and technical assistance contact your representative or write direct.

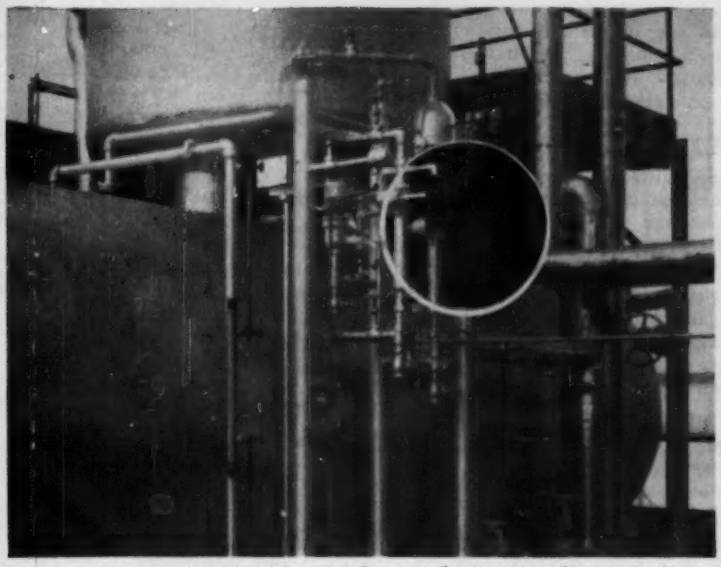
ALL HIGH CQ PRODUCTS

MASON-NEILAN

Division of Worthington Corporation

33 NAHATAN STREET, NORWOOD, MASSACHUSETTS

District offices or Distributors in principal cities in U.S.
In Canada: Mason-Neilan, Division of Worthington (Canada), Ltd.



Masoneilan Liquid Level Controls in Deaerator Service at a southern power plant.

America's historic Atomic Power Plant at Shippingport, Pa. uses these Masoneilan Control Valves for Flash Tank Surge and Blow-Off Tank.

For more facts circle 231 on Reader Service card, p 117

(Advertisement)

HAGAN NEWSLETTER—FEBRUARY

Behind the panel

THE DAY THEY MISSED THE LUNCH WHISTLE

It wasn't planned that way--it was just that this group of engineers got so interested in the PowrMag story that they ignored the lunch whistle. Small wonder--because magnetic amplifiers are claiming top attention from instrument engineers today, and the way Hagan uses them makes them even more interesting. Here is a system that is almost an exact analog of a similar pneumatic system--easy to understand, easy to work with. All the advantages of solid state--no tubes--no transistors--and circuitry that is so simple that maintenance problems become a minor consideration. Passive networks, parts of the compact plug-in box, provide proportional band, reset and rate action. All parts are high-quality components, operated far below their ratings--result, high stability and long life. A unit will use no more than 2 or 3 watts, so heat is no problem. DC signals mean centralized control is possible at any distance, and outputs are compatible with data processors and computers. If you would like to hear more of the PowrMag story, give Hagan a call. (Details on request--Ask for Item L-1)

BOILER FOR SOUTH AMERICAN STEEL MILL FIRES FIVE FUELS--AUTOMATICALLY

Hagan systems, including combustion, 3-element feed water and furnace pressure controls, will be installed on a 53,000 KW station in South America. Two boilers, each producing 350,000 lb. steam/hr., at 900 psig and 900 FTT, will be fired with the following fuels, in the order given: coke breeze, blast furnace gas, coke oven gas, heavy fuel oil. Provisions have also been made to fire pulverized coal at a future date. Because of the number of fuels and the complicated firing procedure, a special set of interlocks have been incorporated into the control system. The boilers are designed to burn a preset rate of stoker-fed coke breeze, so this amount is deducted from the total fuel demand. When required, blast furnace gas is fired if pressure indicates it is available. As demand exceeds this combination, coke oven gas is fired, and so on, all automatically. Operating under typical steel mill load, the combustion control system is designed to follow load swings that may range as high as 60%, with peak intervals as low as two minutes and peak durations of thirty seconds.
(Details on request--Ask for Item L-2)

HAGAN CONDUCTIVITY METER SAFEGUARDS CRITICAL SOLIDS CONCENTRATIONS

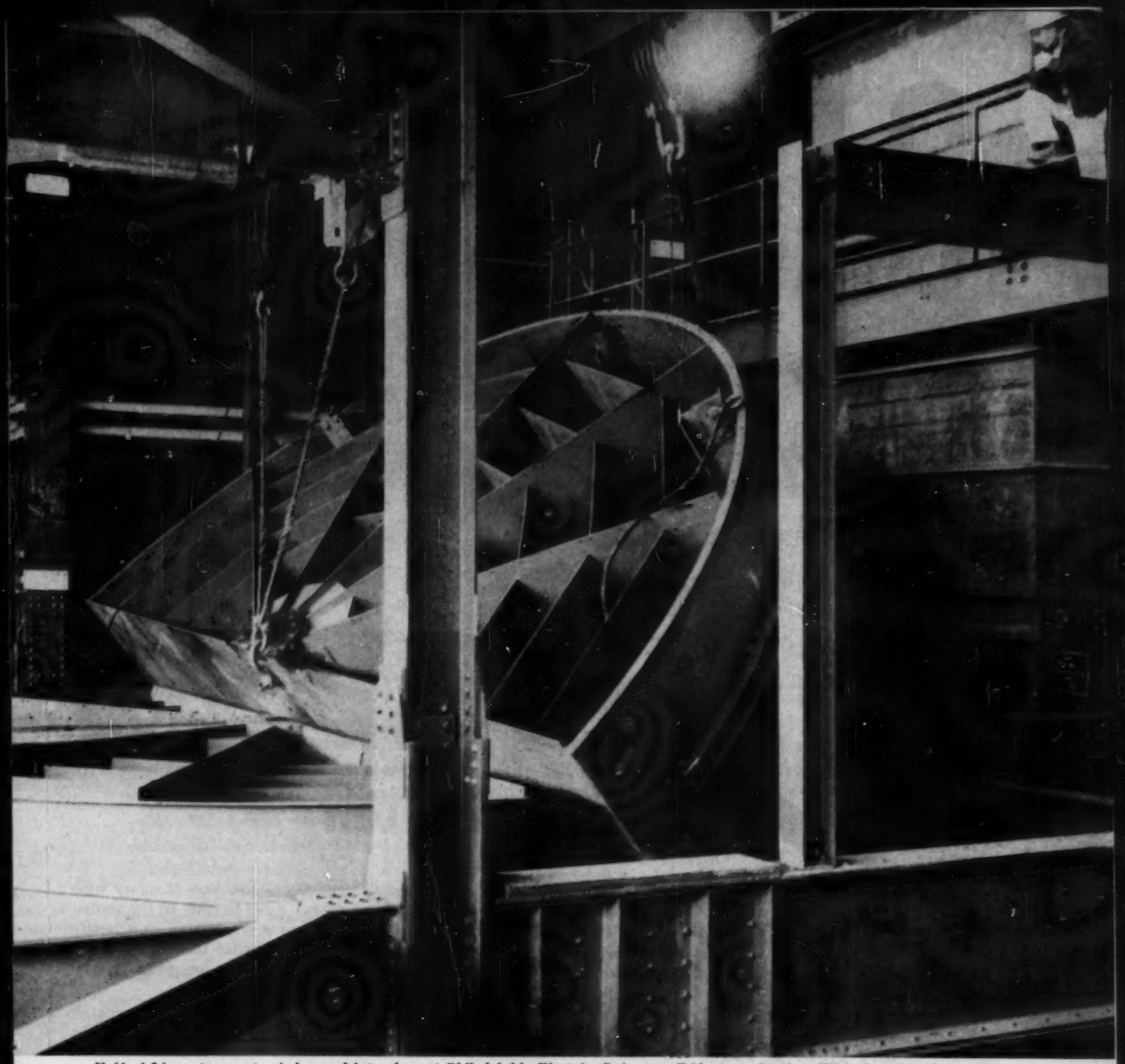
Where the concentration of dissolved solids in a solution is critical, the Hagan Conductivity Recorder and Sampling Cell provides a continuous reliable measurement for a moderate investment. The Hagan Model H-O may be utilized as a single instrument, or up to four different conductivity measurements may be recorded in a single instrument case. The recorder may be mounted up to 1000 feet from the point of measurement. For the determination of dissolved solids in steam, appropriate cooling coils, steam dryers and degassers are available. For feed water and condensate systems, where fluid temperatures do not exceed 140F, the conductivity cell may be used without cooling. Temperature compensation is automatic and continuous, and limit switches may be installed to activate alarms. This protects systems where cooling water leaks into the condensate may occur. (Details on request--Ask for Item L-3)

TOP PRESSURE CONTROL INCREASES BLAST FURNACE EFFICIENCY

Iron production in a blast furnace can be raised by increasing the weight of a gas per cubic foot within the furnace, bringing more oxygen in contact with the burden. Hagan Automatic Top Pressure Control accomplishes this without increasing gas velocity, thus avoiding raising of dust loading. A typical installation in an eastern steel mill made use of existing butterfly valves, one 30", the other 54". Since only the 30" valve had good regulating characteristics, the two valves are operated in parallel, providing adequate capacity for handling system gas as well as system bias. A blocking valve, operated by a limit switch on the charging bell, overcomes the momentary surge that would occur each time the bells were set. Since the installation of the Hagan system, iron production has increased, and furnace operation is smoother. (Details on request--Ask for Item L-4)

HAGAN CHEMICALS & CONTROLS, INC., Hagan Building, Room 711, Pittsburgh 30, Pa.

HAGAN DIVISIONS: CALGON CO. — HALL LABORATORIES — BRUNER CORP.



Half of Ljungstrom rotor is lowered into place at Philadelphia Electric Co.'s new Eddystone Station. When heating element baskets are fitted into the rotor chambers, this unit will provide 201,100 sq. feet of heat transfer surface and will weigh about 525,000 lbs. It will be one of four air preheaters serving a 325,000 KW unit. Two such boiler units are presently being installed.

SAFEGUARDING EDDYSTONE'S **NEW LJUNGSTROMS®** **—LIFETIME AIR PREHEATER SERVICE**

Dependability is standard equipment in Philadelphia Electric Co.'s new Ljungstroms. Each unit is protected by Lifetime Air Preheater Service. That means that *throughout the life of each unit,* Air Preheater engineers make regular calls to inspect the Ljungstroms and keep them in top operating condition.

Air Preheater also shows lively, consistent interest in their *factory* service to customers. For example, when a midwest customer recently ordered emergency replacement elements, Air Preheater's traffic department investigated the cost, speed and control of all commercial shipping methods. In the circumstances, regular trucking would take too long, rail delivery was impractical, other methods prohibitively expensive.

So Air Preheater asked for authorization to ship the replacement elements aboard one of their own trucks. The result: the elements arrived a week in advance of the hoped-for date — and, thanks to Air Preheater's efforts, the customer made significant savings on transportation costs.

In addition to regular field service and fast, competent factory service, Air Preheater offers you over 35 years of experience in solving boiler and preheater problems. These reasons help explain why 19 of the 20 most efficient power stations in the U.S. are Ljungstrom-equipped.

THE AIR PREHEATER CORPORATION

60 East 42nd Street, New York 17, N. Y.

For more facts circle 232 on Reader Service card, p 117

3 STORIES HIGH

200,000 sq. ft. condenser for Widow's Creek Station of TVA

or BROAD and LOW

YUBA CONDENSERS—with the most flexible tube bank layout in the industry—designed to fit any plant or space requirements

This is a three story high, twin-bank condenser—just one of many tube bank layouts possible with Yuba Condensers—most flexible in the industry. Whether you require a giant condenser or a small one, in a single or multiple pass or axial flow design—no matter what the size, type or service conditions, Yuba's flexible design paces the progress in the power industry.

Yuba's twin-bank tube layout, for example, permits turbine exhaust steam to flow unobstructed, with equal distribution throughout the entire tube bank with a free flow to bottom of condenser and into hotwell, where it reheats and deaerates condensate. In Yuba's deaerating condensers, the oxygen in the condensate is guaranteed to be less than 0.005 cc per liter. This design is patented.

For that extra performance, Yuba staggers the tube support plates—reducing harmonics—eliminating vibration. This is just another reason Yuba surface condensers have been installed all over the world in plants of many sizes. For full details, contact Yuba today.

Other Yuba products for steam power plants include Feedwater Heaters, Evaporators, Expansion Joints, Cranes, Tanks, Structural Steel and scores of other items.

YUBA

specialists in power plant equipment

YUBA HEAT TRANSFER DIVISION
4th and Main Streets, Honesdale, Pennsylvania

YUBA CONSOLIDATED INDUSTRIES, INC.

Sales Offices in Atlanta • Buffalo • Chicago • Cleveland • Houston • Los Angeles • New York • Philadelphia • Pittsburgh • San Francisco • Seattle

For more facts circle 233 on Reader Service card, p 117

LOUIS N ROWLEY, EDITOR • FEBRUARY 1960 • ESTABLISHED 1882 **Power**

"K" speaks out on power

I have just finished reading a fascinating document—a translation of Nikita Khrushchev's speech at the recent All-Union Power Development Conference in Moscow. It is long—15 single-spaced legal-sized pages—so all I can hope to do here is give you some idea of its "flavor," and draw some conclusions about the Soviet power position.

To those who followed press reports of Khrushchev's U.S. tour, many of the characteristics of this speech would have a familiar ring: The repeated challenges to the capitalist system. The resounding tributes to the accomplishments of Soviet engineers and workers. The often lengthy expositions of Soviet ideology. And the contrasting pithy proverbs, homely examples and sometimes heavy-handed humor.

In the U.S., Khrushchev never hesitated to venture comment and criticism even in highly technical areas. At home he indulges the same penchant, and often sharpens his critical questions by addressing them to individual engineers in the audience. Why is a 22-unit hydro plant built one unit at a time—why not carry all forward at once and cut construction time? Why can't boiler field erection be reduced by prefabricating larger elements? Why not shrink size and cost of hydro generators by designing the stator to rotate in a direction opposite to the rotor, thereby increasing relative speed?

Through these Khrushchev questions, and others not cited here, runs a common thread of urgency, a sense of a big job to be done, fast! Present output goals are: 900-billion kwhr by 1970, about 1.5-trillion kwhr by 1975, and about 2.3 trillion by 1980. "This means," says Khrushchev, "that within 15 to 20 years we must increase electric power station capacities by about 7 to 8 times."

When we consider that this is equivalent to doubling capacity every 5 to 6.5 years—and remember that U.S. utility capacity has doubled every 8.5 years since the early 1930's—we can see why "K" is ramrodding his power engineers for maximum construction speed. And why he devotes a page and a half of his speech to showing that while "even a fool knows hydroelectricity is cheaper," the current Soviet effort must be concentrated on thermal stations because they can be built faster.

It is also apparent that equipment is not being manufactured at rates high enough to meet accelerated construction schedules, and that some materials, specifically copper, are not as plentiful as they might be. It is equally apparent that Khrushchev is determined that these problems will be solved—and quickly.

This determination to build a strong Soviet power system is not new. Lenin said, "Communism is Soviet power plus the electrification of the whole country." This statement of the interdependence of two kinds of power—political and electrical—was so visibly a cornerstone of Russian thinking that POWER's Shelton Fisher paraphrased it in the opening sentence of his eyewitness report, *Soviet Power Today* (October, 1956). And Khrushchev quotes it again in this recent speech.

Here, at least, is one point on which we in the U.S. can agree with the Russians. We know from experience that abundant, low-cost energy is the foundation for a prosperous free-enterprise economy, essential to a high standard of living. And since kilowatt-hours know no ideologies, abundant energy will build a better way of life for the Russian masses, even under the Communist system.

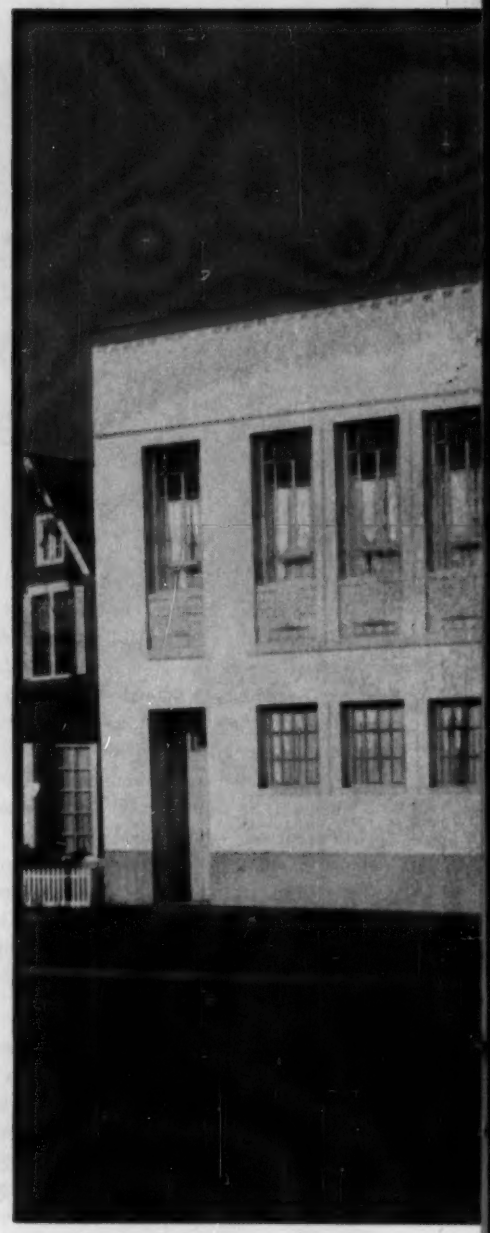
Persons in the know
are specifying fuses

HATFIELD Electric Co.,

a leading electrical contractor,
installs–

FUSETRON dual-element Fuses

in its new office building



This Hatfield Electric Co. installation underscores the need for . . .

LIFE-TIME DEPENDABILITY AND HIGH INTERRUPTING CAPACITY IN A MODERN PROTECTIVE DEVICE — *You Get Both With* FUSETRON Fuses . . .

Mr. Brown, Vice-President tells why . . .

"For our own buildings and our recommendations to our industrial and commercial customers, we feel that FUSETRON fuses are the most reliable means of overcurrent protection that has been made available to us.

"We require protective devices for industrial and commercial application that not only provide adequate short-circuit protection but also protect against needless blows. In dead-front panel equipment it is especially desirable that they operate cool and efficiently. Of course FUSETRON fuses provide this.

"The additional protection features of these devices are of continual interest to our customers, and we feel their use is to our mutual benefit.

"As a matter of further interest, we are remotely mounting the fluorescent ballasts throughout our own offices and adding your fuse blocks with indicating FUSETRON fuses for better protection and lower maintenance."

William L. Brown.
V. P. HATFIELD ELECTRIC CO.
CLEVELAND, OHIO

THERE IS A BUSS OR FUSETRON FUSE FOR EVERY ELECTRICAL NEED

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in this IR compressor

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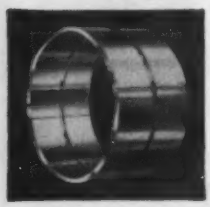
Long before the unit was shut down the customer had ordered new main bearings to keep in reserve stock in event of emergency. It was decided to install the new bearings while the compressor was torn down for inspection. When the old bearings were removed they were checked for wear and were found to be within the original one-thousandth-inch tolerance *for new bearings*. This means that there was *no measurable wear*, even after the equivalent of 20 years of "normal" operation!



Of course, these are not ordinary bearings. They are *aluminum full-floating* bearings, one of the extra-value features found only in Ingersoll-Rand compressors. These heavy-duty bearings roll with the punch of each compressor stroke, distributing the load evenly all around the inside and outside of the shell. Their special aluminum alloy has better load-carrying capacity and higher heat conductivity than other bearing materials. And they *never need adjustment*, so the running gear may be kept sealed from dust and dirt.

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For more facts circle 235 on Reader Service card, p 117

B G A SKROTZKI
Associate Editor in Charge

a Today's Development report

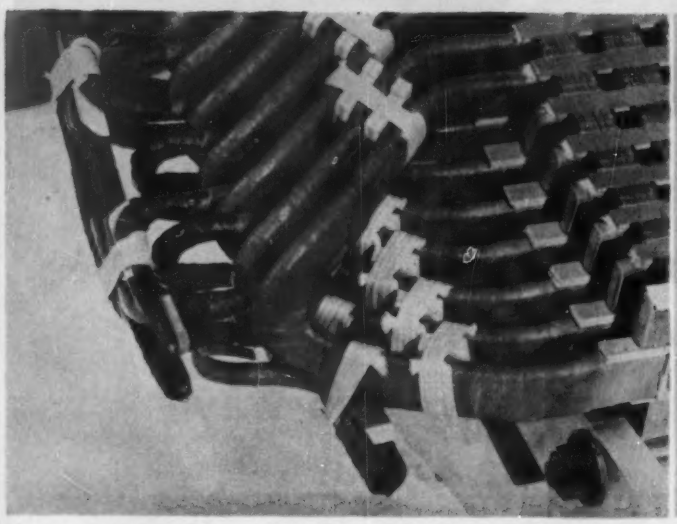
Motor insulation is better than ever: new materials and methods pave the way

- New insulating materials appear in bewildering variety under motor manufacturers' trade names. With wise selection you can solve rough service problems
- Encapsulation—either as solid winding enclosure or as continuous coil insulation—does a good job protecting windings from weather and destructive contaminants
- Silicones, geared to high-temperature needs, are finding use in Class B. They offer a built-in overload factor plus moisture resistance
- Magnet-wire coating is still the toughest spot that insulation must fill in electric motors. Polyvinyl formal is popular for most applications. Epoxies, polyesters and acrylics play an important role

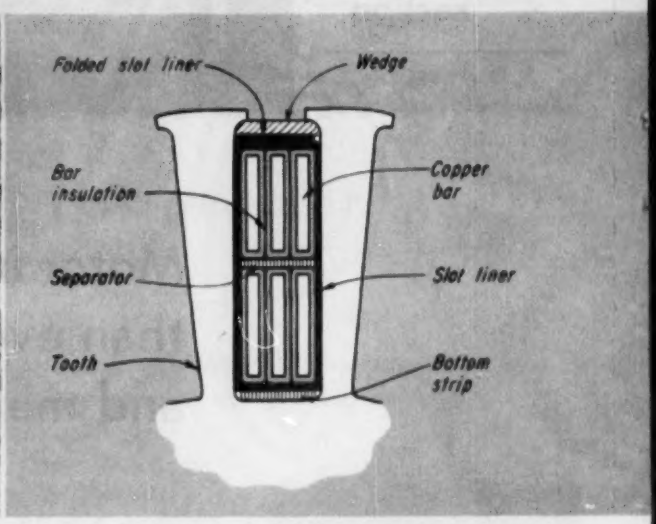
By NORMAN PEACH
Associate Editor

Up to a decade ago you had relatively little choice in insulating materials for electric motors. Even disregarding costs, it wasn't possible to produce a radically different insulating system. Today the picture has reversed. There is such a variety available to the motor designer that he can select insulation to meet almost any combination of requirements for industrial service. Plant engineers have a wide choice of motors identified by various trade names, each representing an insulating system based on one or more of the new materials with a tongue-twister name. Let's see what some of these materials can do in today's electric motors. continued

Formed coils of large stators, rotors and armatures use

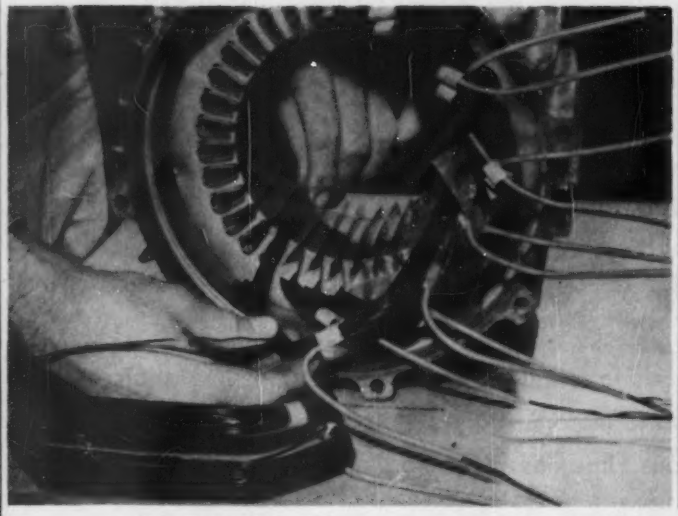


END TURNS and connections must be held in place to withstand mechanical stresses of current surges. Here coils are braced with silicone-glass-fiber laminate and tied with glass sleeving. Coils are lashed to insulated-metal supporting ring

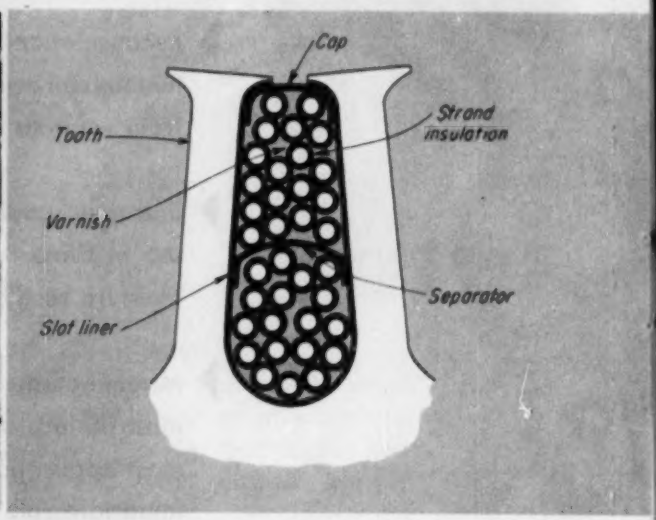


PARTIALLY CLOSED slot is often used on wound rotors; center bar slips in last. Each bar is a turn and is individually insulated. Slot liner is folded over forming completed coil insulation. Wedge is usually a laminate, but may be wood

Random-wound coils depend on slot-cell ground insulation



RANDOM-WOUND stators have sheet insulation (varnished cloth, paper or film) inserted between coils of phase groups or between each coil. Sometimes "nose" is taped. Sleeving insulates coil leads. Note two wires in parallel for extra flexibility

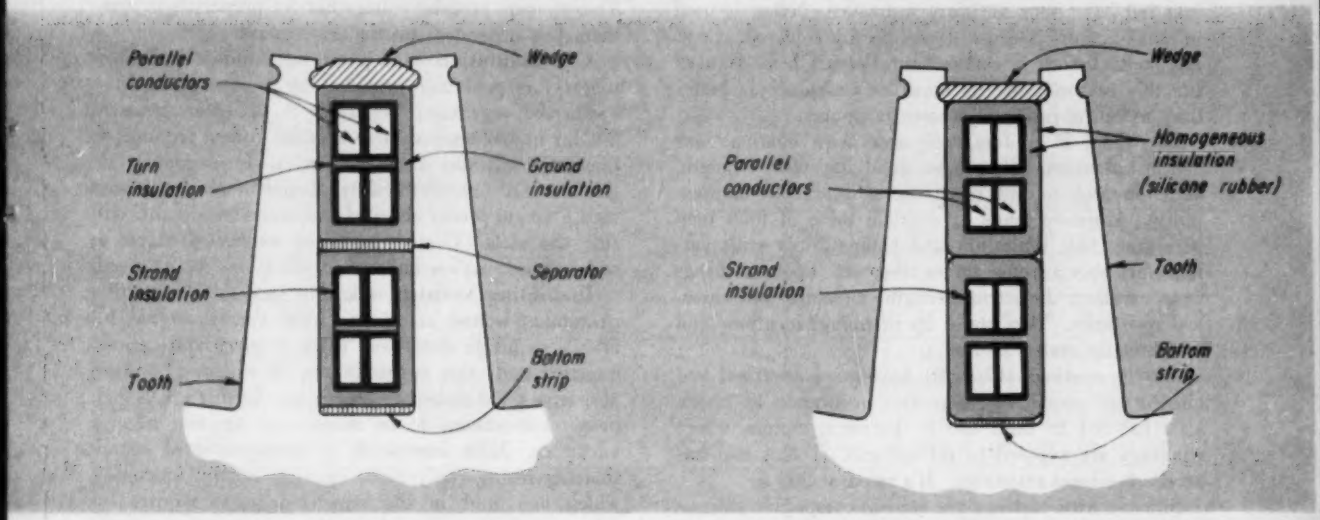


SLOT LINER serves as ground insulation while strand insulation must insulate turns. Separator insulates between coils. Molded cap may close slot, or paper cap may be used with top stick. Varnish is important, keeping wires firmly in place

Second National Conference on the Application of Electrical Insulation, recently held in Washington, brought together top engineers in the insulation field to exchange ideas on evaluation of new materials. It became clear at the conference that the parade of new materials has by no means passed, nor has potentiality of new materials to further revolutionize electric-motor design. With materials available today, insulation no longer need be the "weak link" in the motor. Where cost is justified, insulation life can match other motor components. Motors may be applied to severe service without the frequent rewinding formely a necessary evil. Maintenance and repair costs may be cut.

Insulation is used in many places in electric motors, with different shapes and materials needed to complete the job. Four basic motor windings are illustrated on

insulations that withstand severe mechanical stresses



OPEN SLOT is basic construction for larger stators and armatures. Parallel conductors are sometimes insulated to reduce eddy currents. Turn insulation is thicker with heaviest insulation between coils. Insulation is composite structure

VULCANIZED insulation (also called *homogeneous*) in form of silicone rubber is in wide use today and has been racking up a good performance. Turn and ground insulation is applied as tape on the coils, after which it is formed and vulcanized

these pages. What's more, dc-motor commutators have their own peculiar insulation requirements, as do the slip rings of ac wound-rotor motors. And the dc fields of dc motors and ac synchronous motors have particular insulation needs. Formed parts, such as shells or bobbins for field coils, are on the increase. Surface coatings (paints, varnishes, moisture repellents) protect against contaminants and improve appearance.

Wide variety of insulation used for each function in a modern motor is generally composed of more than one basic insulating material. Combining modifies their properties; keep this in mind when evaluating materials. Chart, p 65, lists the newer—and some older—basic insulating materials and their suitability for typical forms of motor insulation. For example, glass fibers are suited for a number of applications: they can be woven into cloth, sleeving and cord, or combined with resins to form laminates. In latter case, however, high heat resistance of glass is not used to advantage if combined with low-temperature resins (but other properties of glass may recommend it).

Classification of insulation from the early days of electric motors has been based on general thermal properties of basic materials. Example: Class A included cotton, paper, etc impregnated with an organic oil. Today, insulation classes are still specifically tied to temperature but materials may be included in a particular class if experience or accepted tests show them to be capable of operation at temperature of the class. Classes are described in table, p 64. Insulation classifications stem from general principles established by the American Institute of Electrical Engineers (publication No. 1). Temperature rise and hot spots are allowed above the 40-C ambient for motor operation.

Properties of insulating materials required for electric motors, beside dielectric strength, include resistance to mechanical, thermal and chemical deterioration. Insulations must also be compatible with other materials used in the machine—varnish solvents, for example. Thermal conductivity influences hot-spot temperature and consequently thermal aging. In higher-voltage motors (above five kv) corona effects may be a factor. Chart, p 65, lists important properties of basic materials. Ratings *high* (H), *medium* (M), *low* (L) are used to give a general idea of properties and necessarily can't define them to complete satisfaction.

Basic materials of electric-motor insulation are easily classified as organic or inorganic compounds. Latter have outstanding temperature properties. Some of the materials creating greatest interest today are members of the large family of silicon compounds known as *silicones*. There's hardly a type of insulation which doesn't have a silicone counterpart. Among organic insulations, other developments are in synthetic compounds commonly called *plastics*. These, too, serve many functions in insulating a motor and have to a large extent pushed out familiar natural compounds.

Wire insulation is very important in machines where it serves as turn insulation. Most magnet wire is insulated by one or more coatings of synthetic enamel. Single or double glass servings may be combined with the coating. Polyvinyl formal (known by trade names having the syllable *form*) was introduced about 20 years ago and is still the most popular wire coating for Class A motors. It has good dielectric strength and abrasion, moisture and chemical resistance. It's compatible with most varnishes, though subject to some solvent crazing (tiny cracks). **continued**

Nylon (polyamide) coatings have been in use for several years. They behave like polyvinyl-formal coatings but have poor moisture resistance. Nylon is used in small motors because it can be dip soldered. Coating melts before it carbonizes. Polyurethene is used for this reason also; its moisture resistance is better than nylon, abrasion resistance is poorer.

For Class B motors, polyester wire coatings are getting attention. They have good dielectric strength, abrasion and solvent resistance and exceptional flexibility. Moisture tends to degrade them at high temperatures; this limitation and compatibility with various varnishes are now under research. Epoxy coatings have excellent dielectric strength, moisture and chemical resistance. They stand up in humid locations and hermetically sealed motors.

Acrylic coatings (Class B) have good electrical and mechanical properties. Superior resistance to chemicals has led to their use in hermetic motors where windings are exposed to refrigerants. Teflon also has excellent solvent resistance. It's rated at 200 C.

Silicone wire coatings are used in compatible silicone insulation system for Class H. Space factor is comparable to other coatings; abrasion resistance and flexibility are somewhat inferior to polyvinyl-formal or polyester coatings. Silicone-bonded glass-served wire has best thermal stability, improved mechanical strength. For Class H, Dacron-served wire may be used for best mechanical strength, but not above 180 C. Silicones are vulnerable to some chemicals, resistant to others—check specific contaminants your motors may meet before employing silicone insulation.

For ground insulation of random-wound machines, cellulosic paper coated with Mylar film is usually most satisfactory for Class A. At higher temperatures an inorganic fabric like glass cloth is impregnated with a suitable resin (such as silicones for Class H). Effectiveness of such insulation depends primarily on the impregnating resin. Interesting research is working toward production of paper from inorganic materials and from synthetic organics like nylon and Dacron. These papers promise voltage-barrier properties to make them less dependent on the impregnant.

Coil insulation (and phase insulation in polyphase motors) is generally provided by a paper strip or a preformed separator. Separator is fiber for Class A, but for higher temperatures may be formed from glass-fiber mat with any of several resins. Impregnated fabrics are used outside the slots. Trend in smaller motors uses a single precut sheet of insulation inside and outside the slots. Coated paper or varnished fabric is widely used; nylon and other sheets are being tried.

Insulating varnish is key to successful insulation of random-wound machines. Ideal varnish would fill all spaces inside slots, hold wires in place and exclude moisture and other contaminants. It would, of course, also have good dielectric properties. In this area much progress continues to be made over original natural varnishes. Most interesting is development of encapsulating resins (polyesters, epoxies, certain silicones) which are fluid in the unreacted form, require no solvents. Being solventless, they evolve no volatile products while reacting to solid state, and therefore void-free structures are possible.

High-temperature varnishes make possible today's Class H motors. Varnishes available today are based on silicone resins. Fluorocarbon resins also have high thermal stability and outstanding inertness, but are costly and hard to process.

Form-wound coils in smaller sizes may be insulated partly by tape on the coil and by a slot liner (p 62), then impregnated with varnish after winding. More generally, however, insulation is completed on the coil before it is installed in the machine. Smaller, low-voltage motors may be insulated with varnished cloth and tape. Larger machines and those of higher voltage until recently depended on mica for major insulation. Mica is still basis of several modern systems but has found a challenger in silicon rubber.

Mica is applied in the form of tape overlapped around the entire coil, or in the slot portion as a wrapping of sheet material. Mica tape or sheet is usually made by placing overlapping mica splittings on a thin paper or fabric backing and impregnating the whole with a binder or shellac, asphalt or synthetic resin. Extensive research in binder resins has led to use of solventless compounds with superior electrical, mechanical and thermal properties. Research in another direction produced *mica paper* (for low- and medium-voltage applications). To make this material, mica is processed into tiny, thin splittings. These are made up like paper. Finished material, highly uniform in thickness and distribution, is easily impregnated with desired binder. It is cut into flexible tapes and sheets.

Silicone rubber represents big departure from the traditional insulating practices. Coils are covered with silicone-rubber tape (some tapes are triangular in cross section so that overlapping will produce a layer of uniform thickness). After vulcanizing, rubber is no longer tape but a homogeneous covering. Silicone rubber can be employed "unsupported" or in combi-

Insulation temperature classes used today

Class	Maximum temp, C	Description of materials
A	105	Organic materials such as cotton, paper, silk impregnated with varnish. Materials must be proved suitable for this temperature
B	130	Mica, glass fiber, asbestos with suitable bonding substances and varnishes, or materials proved suitable for this range
F	155	Materials, organic or inorganic, which have been proved for this temperature
H	180	Silicone elastomer, mica, glass fiber, asbestos, etc with suitable bonding substances such as appropriate silicone resins
C	over 220	Entirely inorganic materials

Insulation's expanding range spurs application diversity

Basic material	Motor insulation: Wire coating	Papers	Films	Sheets and tapes	Fabrics	Sleeves and cords	Rubbers	Laminates	Impregnants (varnish)	Encapsulants	Formed parts	Properties: Dielectric strength	Compression strength	Tensile strength	Life	Thermal conductivity	Thermal stability	Abrasion resistance	Chemical resistance	Corona resistance	Moisture resistance	Solvent compatibility
Inorganic materials are suited for higher-temperature systems																						
Mica, flake				•				•			•	H	H	L	H	L	H	M	H	H	H	H
Mica, paper		•		•				•			•	H	M	L	H	L	H	L	H	H	M	H
Glass fiber	•			•	•	•		•			•	H	H	H	H	L	H	M	H	H	H	H
Asbestos				•	•	•		•			•	M	L	L	H	L	H	L	H	H	L	H
Organic materials are represented by wide variety of synthetics																						
Silicones*	•			•			•	•	•	•		H	—	—	H	M	H	H	M	H	H	L
Teflon			•	•				•			•	H	H	H	H	M	H	H	H	M	M	H
Epoxies	•			•				•	•	•	•	H	M	M	H	H	H	H	H	M	H	H
Polyesters	•			•				•	•	•	•	H	M	M	H	H	H	H	H	M	H	H
Asphalt				•					•			H	—	—	H	M	M	—	M	M	H	L
Nylon (polyamide)	•		•	•	•	•		•			•	H	H	H	H	M	M	M	M	M	L	M
Mylar (polyester)			•	•								H	H	H	H	M	L	H	M	L	H	M
Phenolics	•			•				•	•		•	H	M	M	H	M	H	M	M	L	H	H
Cellulose fibers		•	•	•	•	•		•			•	M	M	M	L	L	L	H	H	L	L	H
Polyethylene			•	•						•	•	H	M	M	M	M	L	H	H	M	H	H
Polystyrene	•								•			H	M	M	H	M	M	H	H	M	H	H
Acrilics	•				•	•		•	•			H	M	M	H	M	H	H	H	—	M	H

*Organic modifications of inorganic polysilicates

H = high M = medium L = low

nation with glass cloth. Winding connections are also taped and sealed with silicone putty or gum which vulcanizes. Entire winding can be sealed or encapsulated, and is inherently void-free.

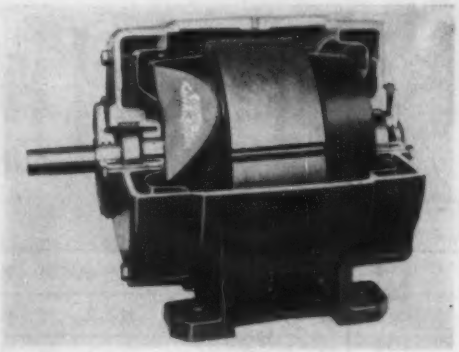
Several manufacturers have lines of silicone-rubber-insulated motors and these motors have turned in a good field performance. Some insulation engineers continue to have reservations, however. Dielectric strength is not as good as high-grade mica insulations of same thickness. Silicone is ordinarily void-free, but critics claim accidental void is more serious in homogeneous insulation layer. Mechanical strength is low.

Outstanding properties of silicone rubber are abrasion and moisture resistance. Some manufacturers recommend cleaning windings with hot water, detergents and low-pressure steam! Abrasive contaminants and carbon black have little effect on these insulations.

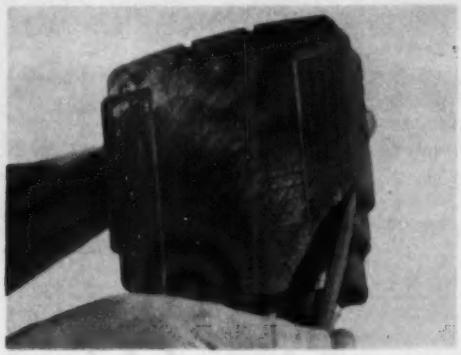
Silicone rubber has spurred manufacture of open all-weather motors, with windings relying on their own insulation instead of motor enclosures. Adequate protection of metal parts is the problem to lick in these designs. Elimination of expensive enclosures has been an important factor in adoption of silicone-rubber-insulated motors in petroleum and cement industries.

Thermal stability of silicone rubber, a Class H material, is excellent. In machines rated Class B, aging of silicone rubber due to temperature is practically eliminated. Corona resistance is good. Resistance to commonly encountered chemicals and solvents is good, but consult manufacturers where unusual chemical contaminants may be present. Oils and some other substances may cause swelling; this damage may not last.

continued



STATOR winding is completely sealed in a cast resin



FIELD COIL cross section shows absence of any voids

Encapsulation solves many protection problems

When solventless thermosetting resins came along, motor designers took a new look at encapsulation, found it has advantages that often justify cost. Encapsulation, strictly speaking, is solid mass covering windings of random-wound machines. Masses consist of cast or molded polyester or epoxy compounds with suitable fillers. Encapsulation compounds have good thermal aging and shock characteristics to minimize possibility of cracking. They are virtually void-free, have good thermal conductivity. Because resin fills slots, likelihood of hot spots is reduced for a greater permissible temperature rise. Motors are usually Class A, but silicone-rubber encapsulation is in use.

Major advantages are protection from moisture and contaminants such as oils, cutting fluids, abrasive dust, graphite. Cleaning is simple: blow them out with compressed air or wash without baking. Encapsulation of dc field coils has been widely adopted both for stationary and rotating fields of synchronous motors, which must withstand centrifugal force and vibration. Many service repair shops are equipped to encapsulate rewound stators, adapting older motors to severe environment.

At present, homogeneous insulation is only possible with silicone rubber. Other materials under development may prove suitable for some types of service. Irradiated polyethylene has been used in an insulating system that seals the winding by shrinkage and tape fusion under heat treatment. This system is Class A. It has been used on stators and dc armatures and field coils. Irradiated polyethylene has high dielectric strength, excellent moisture and abrasion resistance.

Underwater motor, designed to operate immersed in water or other liquids, has been introduced. Its insulating system is based on irradiated polyethylene. In this motor, insulation not only must withstand accidental wetting but must remain continuously impervious to water. Mechanical parts including bearings and magnetic cores also have to stand up under continuous immersion. It's too early to tell how wide an application this motor will have; one place where it's getting a workout right now is in high-pressure boiler circulating (canned) pumps. Advantage here eliminates high-pressure seal. Water from pump circulates through internal electrical and mechanical components of the motor. Manufacturer envisions other applications: deep wells under pressure, dewatering mines, sewage and nuclear-plant operations.

New motor designs include Class H materials in Class B and A ratings. This trend will continue, principally to take advantage of properties other than thermal endurance. Wider use of these materials, of course, helps to bring down their cost. Demand for Class H motors in industry has been estimated at between 1 and 2% of motors sold. This percentage will increase, but not rapidly, as more industrial processes are automated. Manufacturers will expand lines of open weather-protected motors. Experience now being gained will determine applications. Hermetic motors for refrigeration and air conditioning are increasing.

New materals now in development may soon play an important part in motor insulation. Glass flakes (as thin as 0.00004 in.) have been made for flexible composite insulation similar to mica products. Synthetic mica, processable into paper, has been produced; its electrical properties are now being investigated. Cast-plastic slot insulation for random-wound stators is in research. Ceramic insulation, including wire enamel, has been used for extra-high-temperature applications.

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Power's first gas-turbine operating-cost survey

World-wide inquiry brings specific data on 26 plants:

- Locations
- Service type
- Rated capacities
- Installation data
- Plant area
- Operating personnel
- Investments
- Operating costs:
  - Year of 1958
  - First 9 months of 1959
- Output, fuel used
- Hours run, outage
- Fuel costs
- Average efficiencies

Services supplied by 26 plants include:

Electric utility:

6 U.S.A.

5 Canadian

3 South American

1 European

2 Arabian

Gas pipeline:

6 U.S.A.

Industrial:

1 U.S.A.

1 Canadian

1 South American

Here are results of the first world-wide survey of operating costs of stationary gas turbines working in three kinds of service. Returns emphasize the versatility of the gas turbine and its ability to meet economically a wide variety of situations in an even wider variety of geographical locations. Plants reported here represent about 20% of the total gas-turbine plants now running.

Many respondents to the inquiries from POWER found it impossible to separate gas-turbine costs from total plant costs where turbine was part of a steam or diesel plant. Other owners reported that their unit was used strictly for emergency standby and had little or no generating experience, so they did not complete the questionnaire.

All turbines listed are open-cycle. For design details of most of these units see *Modern Plant Survey*, POWER, Mid-September 1956, pp 48-57. The only refinery unit reported was in Sun Oil Company.

Turn page for detailed data ►

Operating costs of 26 gas-turbine plants—

Compiled by B G A Skrotzki, Associate Editor

	Company or organization	Plant, location	Service	Unit rated capacity	Heat recovery, million Btu per hr	Year of initial operation	Turbine rated inlet temperature, °F	Unit rated pressure ratio	Number of shafts	Number of intercoolers	Regenerator effectiveness, %	Plant site area, acres	Plant fuel storage, 1000 bbl	Plant personnel: Supervisors	Operators	Maintenance	Office	Other	Total	Plant investment, $1,000: Land	Structures, improvements	Gas turbines	Heat recovery equipment	Electrical equipment	Miscellaneous equipment	Total
1	Orlando Utilities Commission	Highland, Orlando, Fla, USA[1]	Electric	16.5 mw	0	1958	--	6	1	0	--	10[1]	10.2	-	-	-	-	-	3	10.0	405.0	2730.0	0.0	370	85	3,600
2	West Texas Utilities Company	Ft Stockton, Texas, USA	Base load	5.0 mw 9.0 mw	0	1952 1958	1350 1350	6 6	1 1	0 0	-- --	19.7	0	1	4	1	-	-	6	20.0 -	84.8 67.7	590.0 538.9	0.0 0.0	59.2 33.6	94.1 107.9	848.0 747.6
3	West Texas Utilities Company	Rio Pecos, Girvin, Texas, USA	Base load	5.0 mw	27.1[4]	1954	1400	6	1	0	--	54	0	-	-	-	-	-	3	-	53.7	599.3	75.1 40.0[5]	44.5	23.2	795.8
4	USA utility	Northeastern USA	Electric peaking	5.5 mw 5.5 mw	0	1953 1953	1500 1500	-- --	2 2	1 1	-- --	--	6	1[6]	4	-	-	-	5	12.1	282.3	1706.1	-	643.8	329.7	2976.0
5	USA utility	Northeastern USA	Electric peaking	5.5 mw 5.5 mw	0	1954 1954	1500 1500	-- --	2 2	1 1	-- --	--	6	1[6]	6[6]	-	-	-	7[6]	4.0	227.0	1775.8	-	638.5	268.9	2914.0
6	Public Service Company of Oklahoma	Elk City, Oklahoma, USA	Electric peaking	6.0 mw	0	1951	1500	8.9	2	2	80	6	-	1	1	1	-	-	3	3.0	74.2	720.6	-	56.6	20.3	874.7
7	Canadian Utilities, Limited	Vermilion, Alberta[1]	Electric peaking	5,918.5 mw	0	1954	1165	5.2	1	0	--	5.75	-	-	-	-	-	-	3	-	45	422	-	213	-	680
8	Canadian Utilities, Limited	Sturgeon, Valleyview, Alberta	Base load	6,210 mw	0	1958	1165	5.7	1	0	--	8.39	-	½	4½	-	-	-	5	3	163	512	-	361	40	1,079
9	City of Edmonton, Alberta, Canada	Power, water supply and purification plant	Electric peaking	20/30 mw 20/30 mw	0 0	1958 1959	1150 1150	15 15	2 2	1 1	-- --	353	-	-	-	-	-	-	3	- -	875.8	2906.5	-	162.9	395.7	4,340.8
10	Saskatchewan Power Corporation	Kindersley, Sask, Canada[2]	Electric peaking, standby	6.2 mw 6.2 mw	0 0	1958 1958	1150 1150	-- --	1 1	0 0	-- --	5	-	-	-	-	-	-	-	-	-	-	-	-	-	-
11	Western Chemicals Ltd	Two Hills, Alberta, Canada	Industrial electric supply	6.2 mw	0	1958	1165	--	1	-	--	--	-	1	4	2	-	-	7	3	181	559	-	52.8	90.0	885.8
12	Southern Counties Gas Co of California and Southern California Gas Company	Desert Center, Calif, USA	Natural-gas comp drive	5700 hp	29	1953	1450	--	2	0	80	2.75	-	½	5	-	-	-	5½	-	-	-	-	-	-	1,452
13	Southern Counties Gas Co of California and Southern California Gas Company	Cactus City, Calif, USA	Natural-gas comp drive	5700 hp	29	1953	1450	--	2	0	80	2.75	-	½	5	-	-	-	5½	-	-	-	-	-	-	1,464
14	United Gas Pipe Line Company	Napoleonville, La, USA	Natural-gas comp drive	9000 hp	0	1953	1450	5	2	0	80	59.93	-	1	5	2	-	-	8	-	-	-	-	-	-	-
15	Trunkline Gas Company	Fremont, Texas, USA	Natural-gas comp drive	6350 hp	0	1956	1450	--	2	0	80	40	-	2	10	2	1	-	15	-	-	-	-	-	-	2041.2
16	Trunkline Gas Company	Edna, Texas, USA	Natural-gas comp drive	6350 hp	0	1955	1450	--	2	0	80	80	-	2	10	2	1	-	15	-	-	-	-	-	-	1966.8
17	Trunkline Gas Company	Kountze, Texas, USA	Natural-gas comp drive	6350 hp	0	1956	1450	--	2	0	80	43	-	2	10	2	1	-	15	-	-	-	-	-	-	2033.9
18	SunOil Company	Marcus Hook, Pa, USA	Catalyst regeneration air supply	40,000 cfm 40,000 cfm	0 0	1940 1948	925 925	4.06 4.06	1 1	0 0	-- --	--	-	-	-	-	-	-	3	-	220	260	-	20	-	-
19	Empresas Electricas Asociadas	Santa Rosa, Lima, Peru, SA	Electric peaking, standby	10 mw	54	1949	1112	7.7	2	2	73	0.5	8.25	1	12	-	-	-	13	4.3	71.5	724.0	148.2	88.3	80.8	1132.0
20	Corporacion Peruana Del Santa	Chimbote, Peru, SA	Hydro standby	4 mw	0	1949	1112	4	1	0	--	0.2	4.5	1	3	2	1	-	7	-	-	-	-	-	-	-
21	C A La Electricidad de Caracas	El Covento, Caracas, Venezuela	Electric peaking	20.0 mw 21.5 mw	0 0	1958 1959	1400 1160	4.35 6.5	2 1	1 0	-- --	13.5	3	1	2	2	-	-	5	226	1193.0	3325.0	-	686.5	85.2	5715.7
22	Kraftaktiebolaget Gullspong/Munkfors	Otterbacken, Orebro, Sweden	Electric peaking, standby	27.5 mw	0	1958	1150	16.0	2	1	--	0.8	164.7	½	6	-	½	1	8[7]	-	-	-	-	-	-	683kw
23	C A Venezolana de Cementos	Portigolete, Edo Anzoategui, Venezuela	Electric standby; Electric base-load	1.65 mw 1.65 mw 5.40 mw 5.40 mw	0 0 0 0	1949 1949 1953 1955	1150 1150 1200 1200	3.26 3.26 5.47 5.47	1 1 1 1	0 0 0 0	78 78 77.2 77.2	2.47	0	1	8	2	0	1	12	-	-	-	-	-	-	2482.9
24	Saudi National Co Ltd for Electric Powers	Jeddah, Saudi Arabia	Electric base and peaking	5.0 mw 6.0 mw 6.0 mw	0 0 0	1955 1956 1956	1150 1150 1150	4.5 4.5 4.5	1 1 1	0 0 0	-- -- --	0.3	23.8	2	10	10	1	1	24	-	-	-	-	-	-	-
25	Saudi Arabian Ministry of Finance	Riyadh, Saudi Arabia	Peaking and standby	6.0 mw	0	1958	1150	4.7	1	0	--	1.0[14]	23.3[14]	3	16	4	3	10	36[14]	100	1200	2860	-	430	-	4630[14]
26	City of Lethbridge	Lethbridge, Alberta, Canada[1]	Electric Service	10.0 mw	0	1958	1150	--	1	0	--	8	0.69	-	-	-	-	-	3	-	397	766	-	-	56	1,219

mwh – megawatthour
Period 1 – 1958
Period 2 – first 9 months 1959
1 – Unit in steam plant
2 – Units in plant with reciprocating engines
3 – No personnel added for gas turbines
4 – Exhaust supplies hot combustion air to 300,000-lb-per-hr boiler
5 – Cost of changeover from water heating to boiler air supply
6 – Part time
7 – When operating at base load

electric utility, gas line and industrial

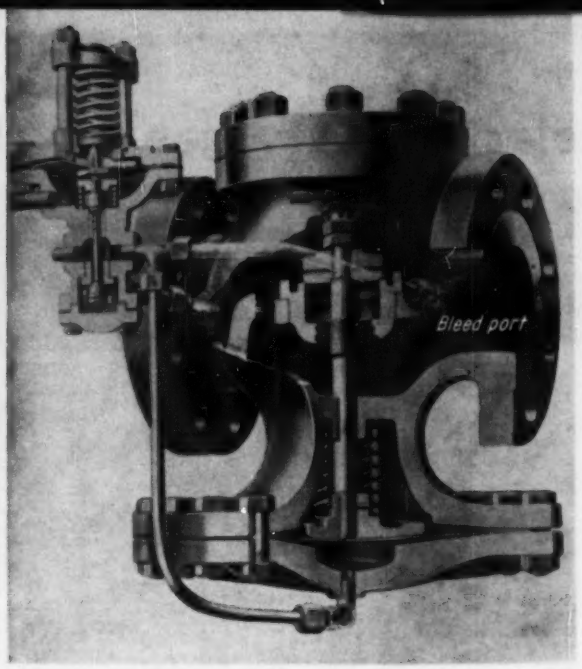
Period	Gross output	Fuel consumed	Hours installed	Hours running	Hours outage	Plant peak load	Operating costs, $1,000: Labor, supervision	Other labor, supplies, expenses	Maintenance, materials and labor	Fuel	Total	Fuel used, kilograms, tons, etc.	Fuel cost, cents per million Btu	Plant heat rate, Btu per kwh*	Plant heat rate, Btu per kwh*	Plant thermal efficiency, %	Employees per 100 kw	Plant factor, %	Operation factor, %	
1	1,041 mwh	4,522,000 bbl	1,152	180	0	16.5 mw	0.54	0.04	0.20	22.52	23.3	26.4	86.8 oil	36,400	-	13	0.40[8]	5.1	100	1
2	20,200 mwh	26,200,000 bbl 304,900 Mcf	13,248	1,793	0	33.0 mw	5.40	0.53	3.15	163.7	172.7	304.9	80.6 oil 30.1 gas	19,000	-	18	0.40	9.3	100	
1	73,281 mwh	1,339,746 Mcf	14,459	13,284	874.2	13.0 mw	27.9	4.7	30.4	99.4	162.5	1,388.9	7.5 gas	17,920	-	19.1	0.6	110.4	130	2
2	54,250 mwh	957,486 Mcf	13,104	9,868	3259.6	13.1 mw	21.3	4.7	42.6	74.7	143.2	957.7	7.8 gas	17,734	-	20.3	0.6	110.0	130	
1	27.1 mwh	734,988 Mcf	8,760	5,482	1,080	5.0 mw	15.1	-	19.7	69.8	104.6	549.7	12.7 gas	20,400	-	16.7	1.1	98.5	100	3
2	20.1 mwh	578,265 Mcf	6,576	3,429	1,560	5.0 mw	9.1	-	15.1	51.2	75.4	432.5	12.7 gas	21,420	-	15.9	1.1	89.9	100	
1	2,405 mwh	321,400 gal	17,520	653	228	12.0 mw	18.3	-	15.1	36.1	69.5	45.1	80.1 oil	16,775	-	20.4	-	2.8	100	4
2	3,209 mwh	300,000 gal	13,140	642	8	12.0 mw	15.7	-	5.5	37.5	58.7	-	-	-	-	-	-	-	-	
1	14,988 mwh	114,800 gal 156,737 Mcf	17,520	2,854	4,710	12.7 mw	44.1	-	46.2	79.6	169.9	211.9	37.6 g & o	14,556	-	23.5	-	15.1	116	5
2	2,745 mwh	111,900 gal 88,092 Mcf	13,140	1,783	6,335	12.7 mw	34.5	-	19.8	45.7	100.0	-	-	-	-	-	-	-	-	
1	747.1 mwh	13,077 Mcf	8,760	193	0	4.1 mw	9.4	0.8	1.1	5.8	17.1	13.2	64 gas	19,485	-	17.5	-	14.2	68.3	6
2	3.0 mwh	113 Mcf	6,552	2	0	2.0 mw	1.0	0.6	0.3	2.8	4.7	0.1	926.79 gas	37,968	-	9.0	-		33.3	
1	2,135.3 mwh	46,931 Mcf	8,760	895	0	7.7 mw	0	1.0	-	8.5	-	45.0	10.4 gas	23,634	-	16.2		43.4	91	7
2	4,282.4 mwh	87,190 Mcf	6,552	911	0	7.6 mw	0	0	-	16.0	-	87.2	18.8 gas	19,488	-	17.5		42.0	92	
1	26,046 mwh	579,405 Mcf	6,792	6,696	0	10.0 mw	19.5	5	8.0	72.0	104.5	610.1	11.8 gas	23,480	-	14.6			100	8
2	28,229 mwh	599,491 Mcf	6,552	6,485	0	10.3 mw	16	3	4.0	66.0	89.0	621.8	13.8 gas	22,162	-	15.4		43.6	100	
1	6,654 mwh	108,649 Mcf	1,608	319	-	28 mw	7.5	1.5	0.04	30.6	39.7	104	13.5 gas	16,250	-	21.0	0.1		43	9
2	69,372 mwh	769,198 Mcf	7,608	2,412	-	56 mw	22.0	6.3	2.98	100.2	131.5	7239	13.5 gas	15,230	-	22.4	0.1	36.0	100	
1	43,408 mwh	804,100 Mcf	-	5,899	-	20 mw	-	-	-	-	-	776	-	18,087	-	18.9	-	-	-	10
2	50,417 mwh	956,800 Mcf	-	8,417	-	20 mw	-	-	-	-	-	923.3	-	18,423	-	18.5	-	-	-	
1	32,731.5 mwh	716,875 Mcf	8,760	7,216	15	6.25 mw	28.6	4.0	3.7	107.5	140.2	711.9	15.1 gas	22,144	-	15.4	1.1	67.6	108.8	11
2	24,342.8 mwh	486,601 Mcf	6,552	-	11	5.98 mw	21.5	6.2	2.5	72.9	97.1	503.2	15.1 gas	23,950	-	14.3	1.1	76.3	87.1	
1	20,901 Mbphr	219,074 Mcf	8,760	3,504	109	7,044 hp	-	-	-	-	127	237.8	26.0 gas		11,377	24.9	-	-	-	12
2	18,746 Mbphr	110,390 Mcf	6,552	1,920	1	7,167 hp	-	-	-	-	79	130.1	27.3 gas		12,186	23.4	-	-	-	
1	32,746 Mbphr	319,255 Mcf	8,760	5,383	32	6,921 hp	-	-	-	-	145	347.9	26.0 gas		10,624	26.6	-	-	-	13
2	31,896 Mbphr	324,747 Mcf	6,552	5,589	9	7,028 hp	-	-	-	-	150	354.0	27.3 gas		11,238	25.2	-	-	-	
1	29,431 Mbphr	271,664 Mcf	8,760	7,602	-	5,900 hp	46.1	7.7	8.8	35.4	98	223.7	11 gas		-	-	0.6	67.1	-	14
2	25,213 Mbphr	286,192 Mcf	6,552	6,169	-	6,200 hp	38.8	6.2	7.9	34.2	87	286.2	14 gas		-	-	0.6	51.7	-	
1	40,265 Mbphr	467,812 Mcf	8,760	-	-	-	72.9	9.3	24.1	70.2	176.5	-	-	-	-	-	-	-	-	15
2	28,774 Mbphr	329,139 Mcf	6,552	-	-	-	55.0	6.4	18.8	44.5	124.7	-	-	-	-	-	-	-	-	
1	47,545 Mbphr	542,855 Mcf	8,760	-	-	-	72.2	8.8	17.9	81.4	180.3	-	-	-	-	-	-	-	-	16
2	36,877 Mbphr	414,985 Mcf	6,552	-	-	-	52.2	6.3	21.6	56.3	136.4	-	-	-	-	-	-	-	-	
1	43,226 Mbphr	496,774 Mcf	8,760	-	-	-	66.4	10.9	26.3	74.5	178.1	-	-	-	-	-	-	-	-	17
2	30,686 Mbphr	360,096 Mcf	6,552	-	-	-	54.0	6.7	19.3	48.9	128.9	-	-	-	-	-	-	-	-	
1	-	1,290 bbl	17,520	17,332	168	40,000 cfm	0	0.14	3.5	3.8	7.6	7.6	50 oil	-	-	-	-	-	100	18
2	-	980 bbl	13,104	12,760	592	40,000 cfm	0	0.36	84.0	2.8	87.1	5.7	50 oil	-	-	-	-	-	100	
1	10,484 mwh	29,500 bbl	8,760	1,405	2,544	9.0 mw	12.1	0.11	1.5	54.6	68.2	172.5	31.6 oil	16,900	-	20.3	1.3	12.1	90	19
2	5,971 mwh	17,000 bbl	6,552	846	600	9.3 mw	9.9	0.07	1.3	38.0	49.4	99.3	36.3 oil	17,050	-	20.0	1.3	9.1	93	
1	3,726 mwh	21,100 bbl	8,760	1,944	0	3.4 mw	-	-	-	-	-	125	29.5 oil	33,000	-	18.4	1.75	38.6	86	20
2	793 mwh	3,470 bbl	6,552	376	0	3.5 mw	-	-	-	-	-	2	41 oil	25,700	-	13.6	1.75	3.0	88	
1	6,910 mwh	82,413 Mcf 2,500 bbl	7,344	456	1,392	21.5 mw	28.3	0.30	0.1	64.9	85.6	-	19.0 gas 156.8 oil	-	-	-	-	-	-	21
2	21,515 mwh	386,185 Mcf 490 bbl	11,568	1,515	7,032	44.5 mw	16.75	0.44	0.5	79.4	97.1	387	-	18,760	-	18.2	0.12	-	-	
1[8]	-	-	8,760	125	-	-	-	-	-	-	-	-	-	-	-	-	-	92	100	22
2[8]	40,527 mwh	-	8,136	1,612	-	-	-	-	-	-	-	-	-	-	-	-	-	92	100	
1[10]	4,945 mwh	89,600 Mcf	17,520	4,506	0	2.2 mw														
2[10]	3,410 mwh	66,700 Mcf	13,104	3,427	0	1.97 mw	12	4.31	0.89	102.1	150.2[13]	-	-	-	-	-	-	-	-	23
1[11]	59,289 mwh	1,070,000 Mcf	17,520	14,822	0	7.44 mw	12	2.75	1.11	79.4	112.5[13]	-	-	-	-	-	-	-	-	
2[11]	42,313 mwh	601,500 Mcf	13,104	11,212	0	7.60 mw														
1	59,012 mwh	162,900 bbl	26,280	9,976	-	10.4 mw	35.2	2.5	25.0	272.0	334.7	8715	31.2 gas	22,100	-	15.45	1.4	26.5	61.2	24
2	43,706 mwh	173,500 bbl	19,656	9,546	4	14.5 mw	26.3	1.8	19.0	291.0	338.1	932.5	31.2 gas	22,200	-	15.4	1.4	37.4	85.3	
1	1,250 mwh	83,800 bbl	1,440	663	0	4.8 mw	3.0	0.16	0.66	27.20	31.02	-	-	-	-	-	-	-	-	25
2	3,671	17,150 bbl	8,552	1,174	0	5.4 mw	5.3	0.30	1.17	55.50	62.27	-	-	-	-	-	-	-	-	
1	18,552 mwh	329,645 Mcf	3,672	-	8	10.0 mw	-	-	5.2	52.9	58.1	315[15]	16.0 gas	16,980	-	20.2	-	50.5	100	26
2	20,250 mwh	356,919 Mcf	6,552	-	2	10.0 mw	-	-	2.0	57.6	59.6	311[15]	18.5 gas	16,100	-	21.2	-	29.4	100	

8 – Jan 1, 1959 to Dec 5, 1959
9 – Total plant includes steam units
10 – For standby units
11 – For base-load units
12 – Period
13 – Based on 425 Bolivars = 1 U S Dollar
14 – For 4 gas turbines
15 – Lower heating value

Single-stage steam reduction may be your best bet

Case against single - stage steam - pressure reduction is losing ground. Today you can avoid noise and maintenance problems and still have single-stage simplicity

By ERNEST GRAFE, Spence Engineering Company Inc
Walden, New York



REDUCING VALVE, a typical pilot-operated model, has no stem packing. Downstream bleed port produces hydraulic balance

Improved valve designs, materials and a better understanding of what causes noise now permit wider use of single-stage steam-pressure-reducing stations. At one time, two stages were considered necessary when supply pressure exceeded 90 to 125 psig with a final delivery pressure of 15 psig or less. So-called ratios of reduction set limits of single-stage application. Depending on experience and whims of the designer, these ratios ran from 5:1 to 20:1.

Flow control. Where range varied to below 10% of rating, it was common practice to break up total flow into two parallel streams. Two pressure-reduction valves were *stepped*, that is, of different size and capacity. Then, at some point of control above the 10% limit, larger valve closed completely and all control was handled by the smaller valve operating alone.

Two stages of pressure reduction, either in series or parallel, obviously cost more than a single stage. Not only are two valves involved, but all of the specialties associated with the valves must be duplicated.

In normal industrial application there should be no arbitrary upper limit of pressure or flow control range for a single-stage station. Other factors should guide your choice between single- and 2-stage installations. Let us look at the progress in valve design and operation that permits wider use of single-stage pressure-reducing stations.

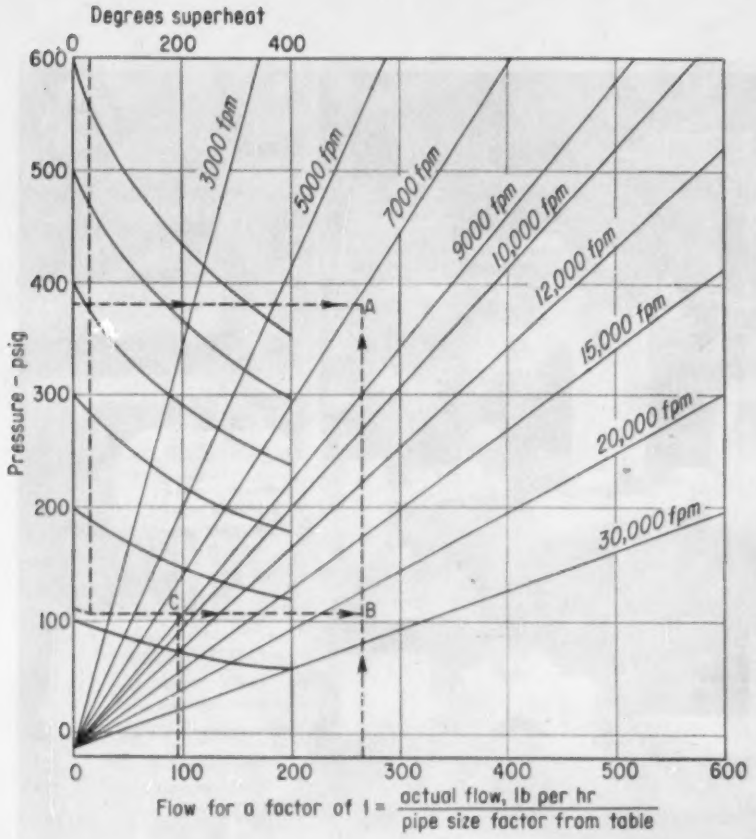
Maintenance. Years ago, when sufficiently hard construction materials were not available, erosive effect of pure steam was significant. Then the reduction of pressure drop across each valve in a 2-stage station may have contributed to longer operating life. Today, however, materials are available to minimize steam erosion. Seats, valves and stems are regularly made of AISI 300 and 400 series stainless steels, sometimes hardened to a Brinnel of 500 or more. Stellite has gained wide acceptance and special electrolizing processes produce hardnesses of 9+ on the Mohs scale.

With pure-steam erosion minimized, accumulated dirt is by far the major cause of valve outage. A 2-stage pressure-reducing station will not help here. Maintenance problems may actually be aggravated, with two valves instead of one to collect dirt and cause trouble.

Noise reduction. A pressure-reducing station can generate some noise in the steam itself, but the noise usually is not at an objectionable level. Since pressure drops to critical in many reducing stations, velocities may reach maximum. But even in a 2-stage station, maximum velocities are reached in at least one valve. Regardless of type of installation, valve bodies are of heavy construction and internal parts designed so the valve itself does not generate too much noise.

Only when turbulence of high-velocity steam excites the downstream piping will the noise level become objectionable. An effective method of noise control is a check of velocities. Reducing-valve outlet velocities of 20,000 to 30,000 fpm are reasonable but they should be promptly reduced to 10,000 to 12,000 fpm in 10-in pipe and larger and 7000 to 9000 fpm in smaller pipe. Reducing outlet velocities by increasing pipe sizes will minimize attendant turbulence and its power to excite the piping downstream from regulating valve.

Install increasers in steps, pipe size by pipe size, and not as one continuous increaser. This permits re-establishing proper flow patterns at each increaser. In addition, the installation of a maintenance-free silencer or a heavy insulation blanket cuts noise while steam velocities are being reduced. It is important to note that a silencer is effective in controlling upstream noise only. Noise originating downstream from the silencer will not be



Use velocity as a guide to station sizing

Steam supply is 380 psig, dry and saturated, through a 2-in. line. Demand is 8500 lb per hr at 110 psig. Select reducing valve and downstream pipe sizes.

From table, below, factor for 2-in. pipe is 32. Therefore inlet-steam flow based on factor of 1 is: 8500/32 = 265. Resultant velocity from chart is 7200 fpm, *A*. After expansion to 110 psig (about 25-deg superheat is produced) velocity is less than 30,000 fpm, *B*. A 2-in. valve is your proper selection.

To maintain downstream velocity at 7000 to 9000 fpm, a 3½-in. line must be used. Actual velocity is 8600 fpm, *C*.

Pipe sizes should increase from 2-in. valve to 3½-in. line in steps of each intermediate pipe size to re-establish proper flow paths.

Use silencer or heavy insulation blanket over increasers if noise reduction is necessary in normal industrial installation.

Pipe factors for standard (sch 40) pipe

Size	⅛	¼	⅜	½	¾	1	1¼	1½	2	2½	3	3½	4	5	6	8	10	12	14	16	18	20
Factor	0.55	1.0	1.8	2.9	5.1	8.3	14	20	32	46	71	95	122	192	278	481	758	1076	1301	1699	2151	2673

reduced. Therefore, be sure that the silencer extends at least to the point where proper velocities as previously outlined have been re-established.

Intermediate pressure. In normal pressure reduction, level of control in a single-stage is higher than in a 2-stage station. With the higher pressure drop across the regulator, less pilot travel is required for a given load range, so you have less variation in delivery pressure as well. Where quick load changes occur there is a second advantage in a single-stage station with its greater pressure drop: pilot has more power available to operate the main valve. A stiffer or faster-responding main valve can be used.

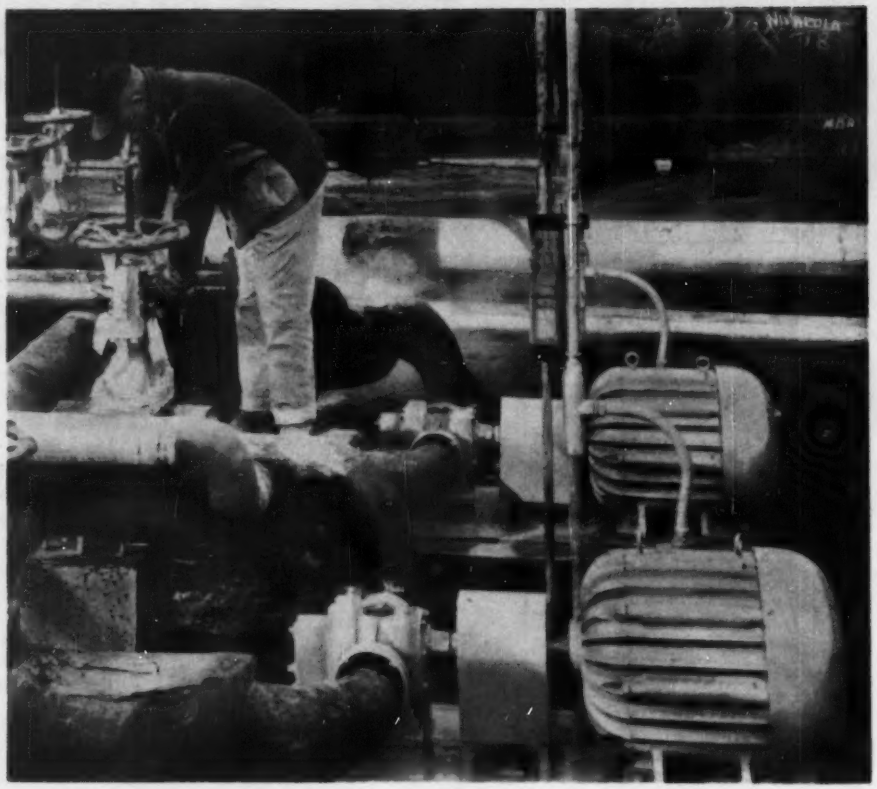
Even when the steam supplied to a plant is reduced to more than one pressure, single-stage reduction offers advantages. Choice lies between two stations in parallel, one for each pressure, or two stages in series where the higher-pressure steam comes from between the stages. Since latter arrangement requires a larger first-stage pressure valve, smaller piping and regulating valves in two single-stage arrangements will have a lower first cost. A bonus: either system operates undisturbed while the other is down for maintenance or valve inspection.

Watch for three exceptions to generally desirable use of single-stage steam-pressure reducing stations.

In underground installations there may be no possible way to install the required safety valves. Here 2-stage stations can be used, but delivery pressure of each regulating valve must be set below the safe working pressure of the equipment served. Likelihood of both reducing valves failing at once is so remote as to be negligible.

Where inlet pressures fluctuate very widely (10:1 or greater), 2-stage reducing stations have special advantages. To produce required flow at reduced pressure, a single regulator might have to be much larger than necessary to carry the load at maximum inlet pressure. A stepped 2-stage-reduction station will permit stable operation free from hunting and chattering.

In areas of critical occupancy such as hospitals, where normal industrial noise levels cannot be tolerated, 2-stage reducing stations may be needed. But in a school, for example, single-stage stations would be acceptable since here the warming-up period usually occurs early in the morning before the building is occupied.



UNLOADING PUMPS transfer fuel oil at a large Southeastern paper mill. These rotary gear pumps are equipped with internal timing gears and bearings; pumping gears only deliver fluid, do not drive

Use rotary pumps for . . .

Low capacities—high heads—fluids that lubricate — positive displacement—high or variable viscosity. However, be sure you know characteristics of each type so you'll buy best pump for your job

By A A ZALIS, Chief Engineer, Rotary Pump Div, Warren Pumps Inc

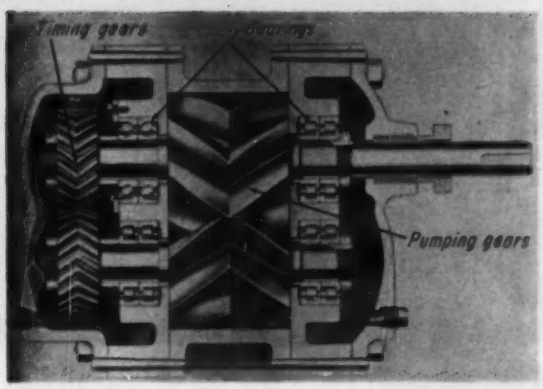
Rotary pumps are best known for handling fuel and lubricating oils where flow must be held constant regardless of changes in viscosity or discharge pressure. Applications may sometimes seem to overlap the fields of centrifugal and reciprocating pumps, but often a particular characteristic of the service indicates the need for a rotary pump. Varying viscosity changes head-capacity characteristics of centrifugal pumps, and this frequently cannot be tolerated. Pulsation problems may preclude consideration of a reciprocating pump.

Rotary pumps described in this article divide into two general classifications, rotary gear and rotary screw.

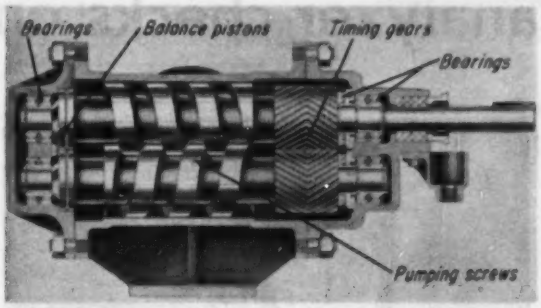
Rotary gear pumps come in two types: (1) external gear—pumping gear may also drive (2) internal gear—one pumping gear has internal teeth.

External-gear pump rotors may be designed for both pumping and driving. Designers must pay careful attention to accepted gear formulas in designing rotors. To both drive and pump, the gear requires a large number of teeth and a large pitch diameter. Resultant high pitch-line velocities must be minimized by low rotative speeds. Because the large pitch-line diameter gives you a correspondingly large outside diameter, bearing loads are on the high side in this pump.

Rotary gear pumps equipped with timing gearings are more efficient than units without timing gears. Timing



ROTARY GEAR PUMP with timing gears and separate bearings uses herringbone gears to keep rotors in axial balance



ROTARY SCREW PUMP with radial and thrust bearings has two balance pistons to minimize thrust load carried by bearings

gears mean pumping rotors can be designed for fluid delivery only. Then primary consideration in rotor design is keeping a good seal between gears and casing with little regard for conventional tooth design. This permits low pitch-line velocities at high shaft speeds.

Timing gears are designed for power transmission only with careful attention to good gear-design principles such as fine diametral pitch and a large number of teeth. In this type of rotary gear pump, small rotor diameters reduce bearing load.

Internal-gear rotary pumps have a hollow, spider type idler gear driven from within by a small external gear. Driving-gear center is not coincident with that of the idler. The two mesh at one point only, forming a seal between suction and discharge openings. Liquid fills void between teeth of both idler and driving gears and is pushed out as gears start to mesh near the discharge port. A stationary crescent-shaped piece seals between the idler and driving gears where they are unmeshed. Pitch-line velocities are relatively high in this type of pump, so large units are operated at low speeds.

Efficiency of rotary gear pumps is good at low pressures due to reduced internal friction. But at high pressures their volumetric efficiency is reduced enough to lower mechanical efficiency — often to a significant degree.

Screw pumps without timing gears have a power rotor and one or more idler rotors. These pumps usually do not have separate bearings but depend on the casing or liner to act as a bearing. Pumping screws are fixed in design so that any change in lead requires a diameter change. Because some screw pumps are not inherently in hydraulic balance, each rotor requires a balancing piston to minimize axial thrust and bearing load.

When timing gears and bearings are included, rotors are suspended in bearings and maintain a definite clearance between pumping screws and casing bore. Then the screws pump only, and their design can be changed to produce exact pumping requirements. Timing gears also prevent metallic contact between intermeshing screws.

Screw pump is better suited to high-pressure pumping than the gear pump. It is inherently quieter, has a smoother, pulseless flow and a higher volumetric efficiency. It can handle more-viscous liquids with greater ease and can operate at higher suction lift. High volumetric efficiency at high pressure gives it good mechanical efficiency. But larger internal surface areas cause greater friction losses than in gear pumps. This gives a lower mechanical efficiency at low discharge pressure.

In addition to these common rotary pump types, there are many highly special designs available for particular applications. These include sliding-vane rotary pumps where driven rotor contains several radial vanes free to slide in and out during each revolution. Liquid is trapped between the extended vanes and is discharged when they are forced back into the rotor by the casing. Flexible-vane rotary pumps are available for food handling.

When specifying rotary pumps—either gear or screw type—be sure to provide full information:

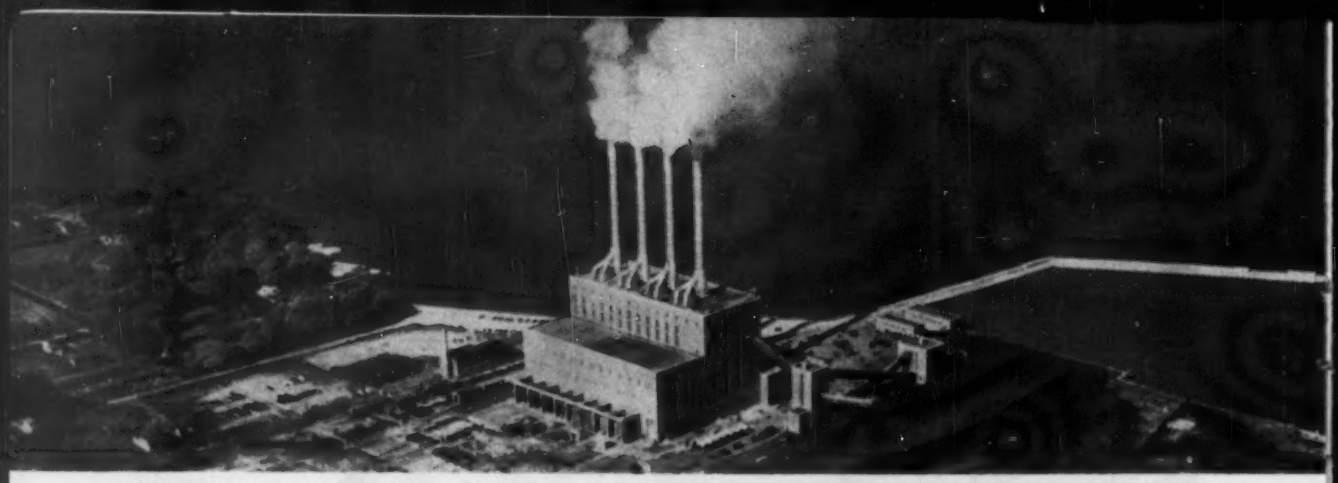
(1) Complete description of liquid to be pumped
(2) Location of installation—indoors or outdoors
(3) Operating viscosity and temperature
(4) Variations in viscosity with temperature, especially outdoors; ambient-temperature range
(5) Required capacity, gpm
(6) Required discharge pressure, psig
(7) Suction conditions, psig (or lift, if any)
(8) Motor-current characteristics and enclosure desired if motor is to be provided with pump. If owner will provide motor, manufacturer must advise hp and speed based on pump selected.
(9) Any special features such as mechanical seals, steam jackets, relief valve or coupling guard.

Calculate rotary-pump efficiencies

Watch for a future article by A A Zalis on calculation of rotary-pump efficiencies and horsepower. He will detail factors influencing volumetric and mechanical efficiency as well as effect of speed change.

Correction

In Jan 1960 issue, pp 78-81, *Con Edison tests prove high-flow-rate demineralization*, we should have mentioned that Illinois Water Treatment Company cooperated in the pilot program and provided the test demineralizer

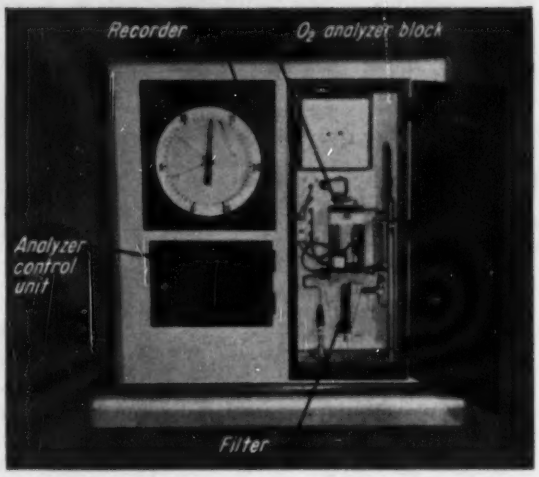


OSWEGO STEAM PLANT of Niagara Mohawk Power Corporation uses traveling analyzer instruments to supplement plant controls

Oswego's portable analyzer checks on oxygen corrosion

Portable dissolved-oxygen analyzers permit detailed checks of the corrosion-control effectiveness in steam-water cycles. Try this technique for fast location of corrosion-prone areas

By R C TUCKER, Laboratory Supervisor
Niagara Mohawk Power Corporation, and
T J KEHOE, Electrochemical Supervisor
Beckman Instruments, Inc



PORTABLE ANALYZER consists of panel-mounted chart recorder, analyzer block and sample cooler, in compact, wheeled cabinet

Today's modern power plant is highly dependent upon the quality of water and steam in its boiler circuit. From a corrosion standpoint, this quality determines life expectancy of much plant equipment, and amount of unnecessary downtime due to tube or equipment failure.

Whenever corrosion due to water is considered, dissolved-oxygen concentration in the water plays the most important role. Generally speaking, a measure of dissolved-oxygen concentration of a particular stream within the water-steam cycle reflects corrosion potential of that stream and condition of equipment exposed to it.

Dependable measurements of oxygen concentrations in power plants are extremely difficult to make because each boiler cycle reacts differently to standard treatment programs, dissolved-oxygen levels, etc. Although manual analyses may be accurate, they are time-consuming, require high technical precision and at best are merely spot checks representing transient conditions. Accuracy of standard analytical procedures may not be adequate to distinguish one or two ppb—sometimes important. Also, load changes and other variables can drastically alter oxygen level, must be correlated with analysis.

Under these circumstances the need for a continuous, highly accurate dissolved-oxygen analyzer for thorough evaluation and study of water-steam cycle is clearly indicated. A portable Beckman dissolved-oxygen analyzer, above, was used for these studies at the Oswego Plant of Niagara Mo-

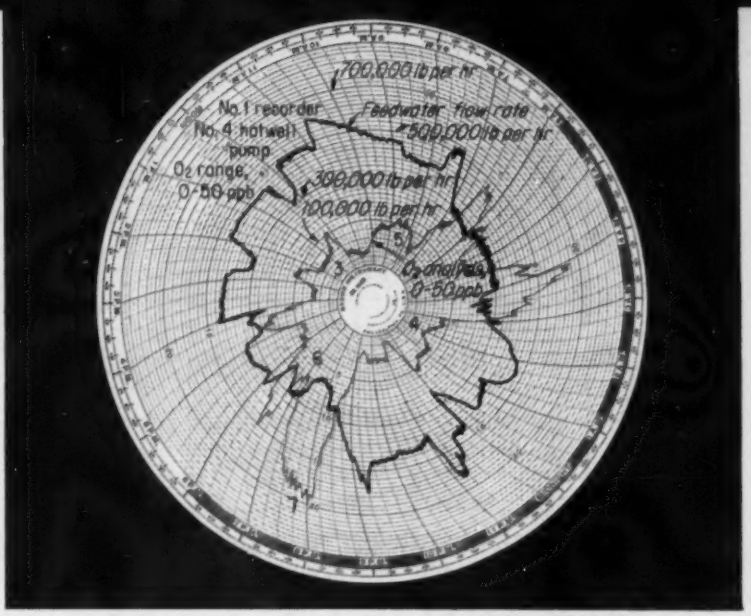
hawk Power Corporation. Portable unit includes recorder, sample cooler and related accessories so that critical flows can be analyzed continuously at point where sample is conveniently available. (A portable unit serves little purpose once cycle studies are accomplished, so stationary analyzers usually handle the day-to-day monitoring of specific critical streams.)

Extreme sensitivity of portable analyzer points up effect of air leakage into any part of cycle. Air can enter the cycle at leaking pump seals, valve packings or pipe fittings, and at condensers or related equipment where negative pressure prevails. It's also possible to have back diffusion of air through a leaking gasket or weld even though the stream is under pressure (dissolved-oxygen analyzer went off-scale when a small jet of steam discharged through sample-tubing leak). Failure of deaeration equipment to adequately remove oxygen, or inadequate chemical scavenging treatment, permits leaking oxygen to accumulate within the cycle.

If air leakage into system is taking place, concentration largely depends on prevailing steam load. Upper chart and table, right, show that oxygen concentration varies as unit load changes, and reflect dilution of a fairly constant air leakage into the cycle. Exception to this occurs when unit load decreases to a point where part of the cycle, previously under pressure, develops a negative pressure and allows more air to enter the cycle.

Efficiency checks of oxygen-removal operations represent a second important use of continuous dissolved-oxygen analyzers. Lower chart shows a 24-hr recording of dissolved-oxygen concentration of water from the condenser. Throttling of steam jets, which collect and remove gases present in the condensing water, markedly affects oxygen concentration of the resulting water. Opening the jets at two am under low-load conditions reduced oxygen from 125 to 43 ppb. Subsequent throttling of jets raised oxygen level to about 140 ppb. Opening jets at eight am, coupled with increasing load conditions, reduced oxygen concentration to about 30 ppb. Repacking the two hotwell pumps ultimately brought concentration down to a few ppb.

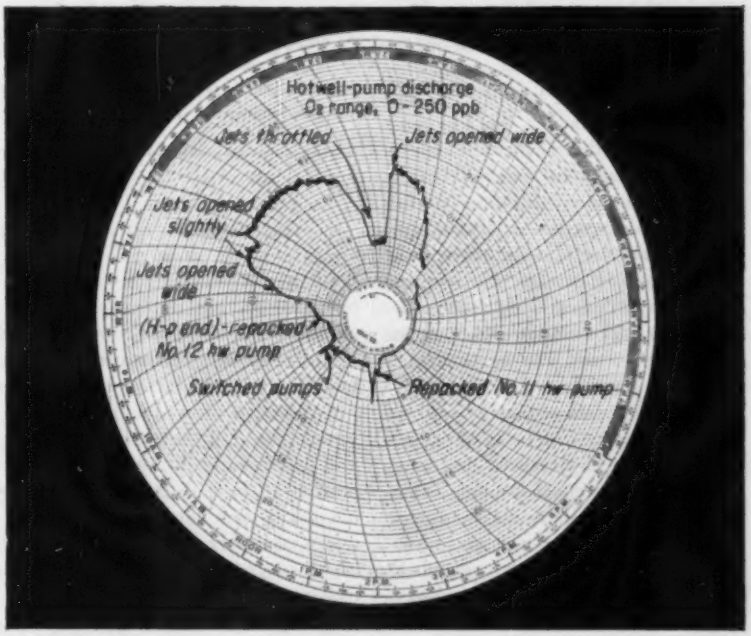
Tracing oxygen concentrations



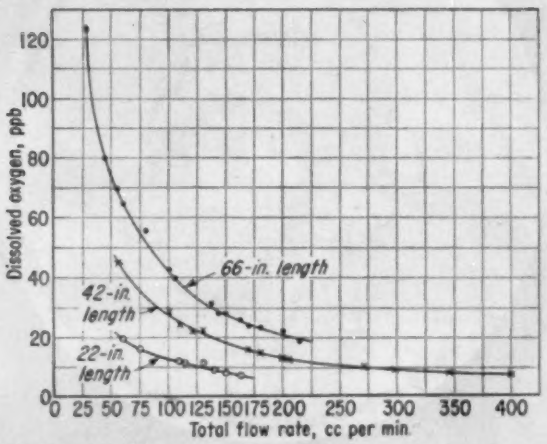
O_2 CONCENTRATION increases as feedwater flow decreases; O_2 in cycle stays even

Load swings boost O_2 concentration

Feedwater flow, lb per hr	Measured O_2 concentration, ppb	O_2 concentration, ppb, based on 00.204 lb per hr constant entry rate	O_2 increase due to load drop	
			Ppb	Increase, %
680,000	3.0	3.0	0.0	0
500,000	4.4	4.1	0.3	7
460,000	5.4	4.4	1.0	23
470,000	6.0	4.3	1.7	40
400,000	10.5	5.1	5.4	106
300,000	15.0	6.8	8.2	120
200,000	38.0	10.2	27.8	270



CYCLE ANALYSIS by charts shows the effect of steam jets on deaeration efficiency



OXYGEN LEAKAGE through walls of plastic tubing affords a reproducible oxygen-leakage standard for calibration checks

through the cycle can alert operators to losses of oxygen by corrosion reactions. We used two analyzers—one to measure hotwell-pump discharge and the other to measure No. 4 heater discharge. Oxygen concentration of both samples varied with unit load as described, but No. 4 heater discharge consistently averaged about one-half the oxygen concentration of the hotwell-pump discharge. Typical readings were: feedwater flow—180 mlb per hr; hotwell-pump O_2 discharge — 35 ppb; No. 4 heater O_2 discharge—18 ppb.

Since there is no possible means of oxygen removal by deaeration or chemical treatment between the hotwell and No. 4 heater, this loss must be due to creation of metallic oxides.

Analysis accuracy must be of the highest order for maximum usefulness of the results. Analyzers employed make use of a calibrator built into the sample stream. Current applied to stainless-steel electrodes disassociates part of the stream. Amount of oxygen formed can be calculated by use of Farraday's Law, by incorporating flow rate at time of calibration. This increase in total-oxygen concentration is measured and compared with theoretical amount. Table, above, records data taken during calibrations and the average agreement obtained. Closer agreement between calculated and observed oxygen increase can be obtained by more-accurate control of current and sample flows. Agreement of 0.3 ppb can be achieved, but normally such accuracy is not necessary.

Electrolysis supplies O_2 input for calibration

Time, am	9:35	10:50	2:30
Header flow, ml per min	210	200	195
Cell flow, ml per min	26	27	27
Total flow, ml per min	236	227	222
Milliamp	.7	.7	1.5
Chart reading, nine ppb	4.2	4.0	4.0
Calculated increase, ppb	15.1	15.3	33.6
Calculated increase plus reading	19.3	19.3	37.6
Observed increase plus reading	18.0	19.0	38.8

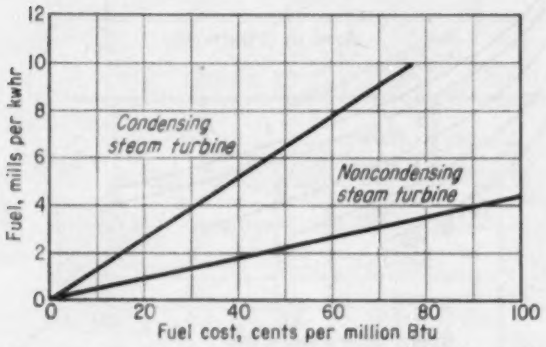
Calibration techniques were modified by introducing known variable amounts of oxygen into the total sample ahead of the analyzer. Standard calibrator electrolyzes only the portion of flow to be analyzed and not the bypass flow. A special electrode assembly was used with a higher-output calibrator for electrolysis of total analyzer flow to gain earlier described calibration data, but it was felt that the average user would prefer a less-elaborate approach. We found that diffusion of air through standard laboratory plastic tubing can be a relatively constant function.

We used various lengths of plasticized polyvinyl chloride, and results indicated amount of oxygen added to that already present was a relatively predictable quantity depending upon total flow through tubing and tubing length. A manifold was assembled so that the flow could be routed through any one of the plastic tubes or bypassed around them. Because of type of tubing used, manifold was located downstream from the pressure reducer to avoid tube rupture. Curve, above, illustrates results attained. Much of the data was taken at scattered intervals to test reproducibility of the method.

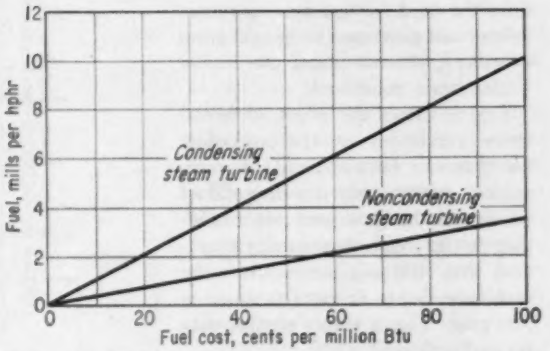
Results can only be considered preliminary in nature since not all parameters affecting the data have yet been explored. Regardless, the general method offers a means of admitting controlled amounts of oxygen into the system to study transport lag, response rate and recovery time of system and analyzer. Hydrazine, used as a chemical scavenger, sometimes can shorten life of resin column used ahead of the analyzer. Occasionally applying a dose of high-oxygen-bearing water may prevent accumulation of hydrazine in the column. Oxygen can be introduced by an automatically timed solenoid-valve bypass network in the sample line ahead of the analyzer.

Our results showed how a continuous analyzer can be put to work to reveal operational conditions that otherwise would not be apparent. Leakage of air into the feedwater or steam cycle and inefficient dissolved-oxygen removal can harm operation of the entire power plant. All efforts to safeguard the boiler unit and to prolong its useful life are easily justified. Continuous monitoring of critical streams to measure the dissolved-oxygen concentrations prevailing is one of several measures you can take to provide optimum operation and detect process misoperation.

Source of basic information contained in this article was ISA paper 0-4325, presented at 13th Annual Instrumentation and Automation Conference, Sept 1958, at Philadelphia, Pa.



1 Fuel cost chargeable to electric-power generation in industrial plant; condensing unit is 12.5-mw using 850-psig 825-F steam, 2-in.-Hg abs exhaust, 83% boiler effy, 5% auxiliaries



2 Fuel cost chargeable to mechanical-drive turbine in industrial plant; condensing unit is 10,000 hp using 850-psig 825-F steam, 2-in.- Hg abs exhaust, 83% boiler effy, 5% auxiliaries

How to use steam turbines in refining, petrochemical and chemical industries

Integrating m-d turbines into a plant process layout can produce low-cost kwhr as well as shaft power by extracting or exhausting the steam to meet lower pressure needs

By W B WILSON, Industrial Engineering Section, Apparatus Div, General Electric Company

Mechanical-drive steam turbines are built in ratings to 25,000 hp or more as needed to match the application requirements. These turbines have universal acceptance in the process industries because:

(1) Speeds up to 10,000 rpm or higher (depending on rating and steam conditions) are available to match speed of driven equipment without need for a step-up gear.

(2) Wide adjustable speed range is an advantage when evaluating process operating flexibility and control.

(3) Temperature of steam-using processes can be controlled accurately when supplied from the turbine's pressure-governed automatic extraction or exhaust.

(4) Automatic-admission or extraction-admission turbines can generate power by taking excess steam from process units or from the exhaust of other turbines and expand it to the pressure level of condenser or lower-pressure process.

(5) Governing automatically responds to any process variable to be controlled, such as pressure, flow, temperature.

(6) Turbines can be installed in areas with explosive atmospheres.

(7) *Low-fuel-cost* power can be produced when all heat in the steam extracted or exhausted from the turbine is needed for process or other power uses.

Fuel chargeable to power. The noncondensing steam turbine, supplying power (hp or kw) and steam for process, generates power with one-half the Btu per kwhr or hphr needed for even the most modern power plant generating power only. Fig. 1 shows the fuel chargeable to electric power with condensing and noncondensing turbines. Fig. 2 gives similar data for mechanical-drive turbines.

Byproduct power is the power that can be developed when steam expands from some higher pressure (as from a power boiler) down to the pressure needed for process or other plant uses. In recent years, power demands in the process industries have grown more rapidly than the process-heat demand. To generate an optimum amount of low-fuel-cost byproduct power and to mini-

mize the need for condensing power (either self-generated or bought from a utility), process plants use higher initial steam conditions.

Fig. 3 shows the effect of initial steam conditions on the byproduct kw that can be generated. For instance, three times the byproduct power can be generated with 1450-psig initial steam than can be generated with 400-psig steam when the turbine exhausts or extracts steam at 200 psig. Fig. 4 shows similar data for m-d turbines.

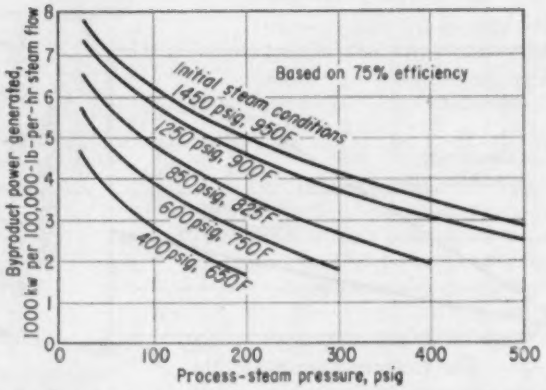
Initial steam conditions. In the economic evaluation of alternate systems, the user is continually faced with the increased initial investment needed to realize a reduction in operating costs. Application requiring higher inlet-steam flow can more readily justify higher initial steam conditions. Fig. 5 shows the range of initial steam conditions chosen for most industrial-turbine applications. This is not intended as a rigorous application guide because there can always be local conditions that make other steam conditions economic.

Topping smaller turbines. Fig. 3 suggests the possibility of using a "topping" turbine-generator to produce low-fuel-cost byproduct kwhr when exhausting or extracting steam to power the many m-d turbines throughout the process area. Turbines in the process area often are too small to economically justify initial steam conditions higher than 250, 400 or 600 psig. Even so, if the total steam flow needed for a group of these smaller turbines can be supplied from the exhaust or extraction of a larger topping turbine it may then become economic to install higher-pressure boilers and generate additional low-fuel-cost byproduct kw. Fig. 5 shows general range of steam conditions economic for turbines having different flow capacities.

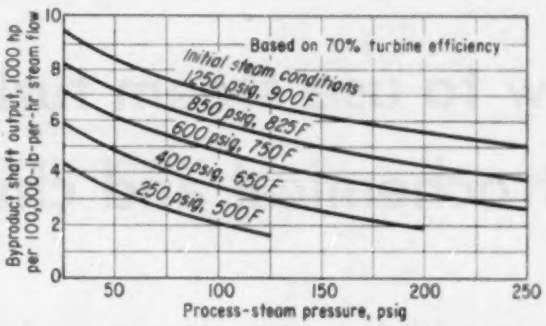
With this arrangement, the h-p power boiler and its piping are confined to the powerhouse. Steam is extracted or exhausted from the main power turbine at the pressure most economic for overall plant distribution and power production with the mechanical-drive turbines.

When large m-d turbines are needed, they may logically be selected for topping. Additional low-fuel-cost byproduct power is available when boilers can be designed for steam pressures higher than would be economic if only condensing or smaller m-d turbines were considered.

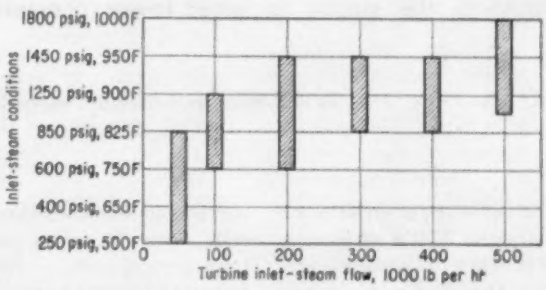
Automatic extraction, admission. Many process plants can raise the flexibility of their steam and power system by adding one or more automatic-extraction or automatic-extraction-admission turbines. These turbines can compensate for variation in the demands for process-steam use and at the same time control the steam pressure in process lines. Horsepower output can be maintained constant or varied simultaneously with extraction flow by the govern-



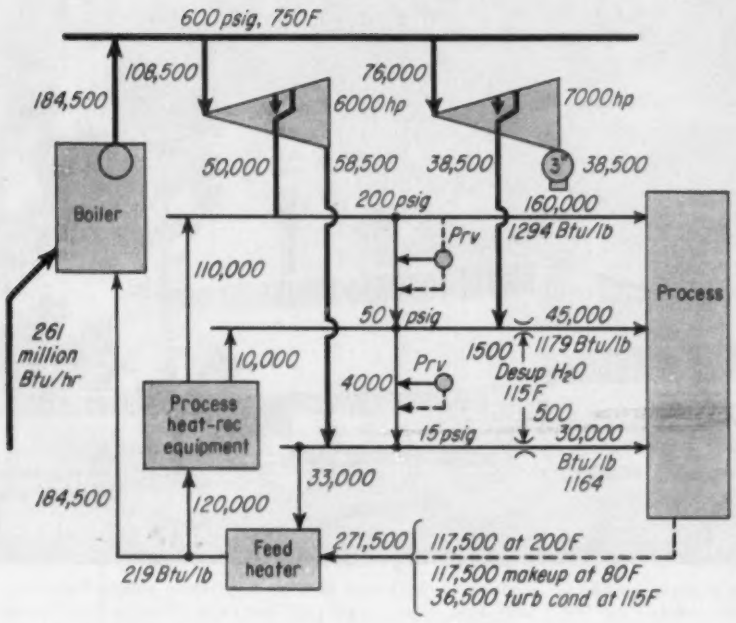
3 Byproduct electrical energy available for range of initial steam conditions and given process-steam-pressure levels



4 Byproduct shaft-horsepower output available for range of initial steam conditions and given process-steam-pressure levels

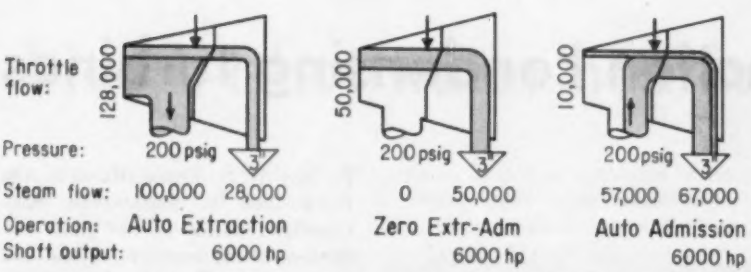


5 Usual range of inlet-steam conditions used for most industrial turbines with given rates of throttle inlet-steam flow



Numbers are flow in lb per hr except as noted

6 One condensing and one noncondensing automatic-extraction turbine, together with two pressure-regulating valves (Prv), supply process steam to three pressure levels



7 Condensing automatic-extraction-admission turbine can produce shaft output of 6000 hp with initial steam at 600 psig and 750 F with any of three alternate steam flows

ing mechanism, which automatically controls flow to turbine sections.

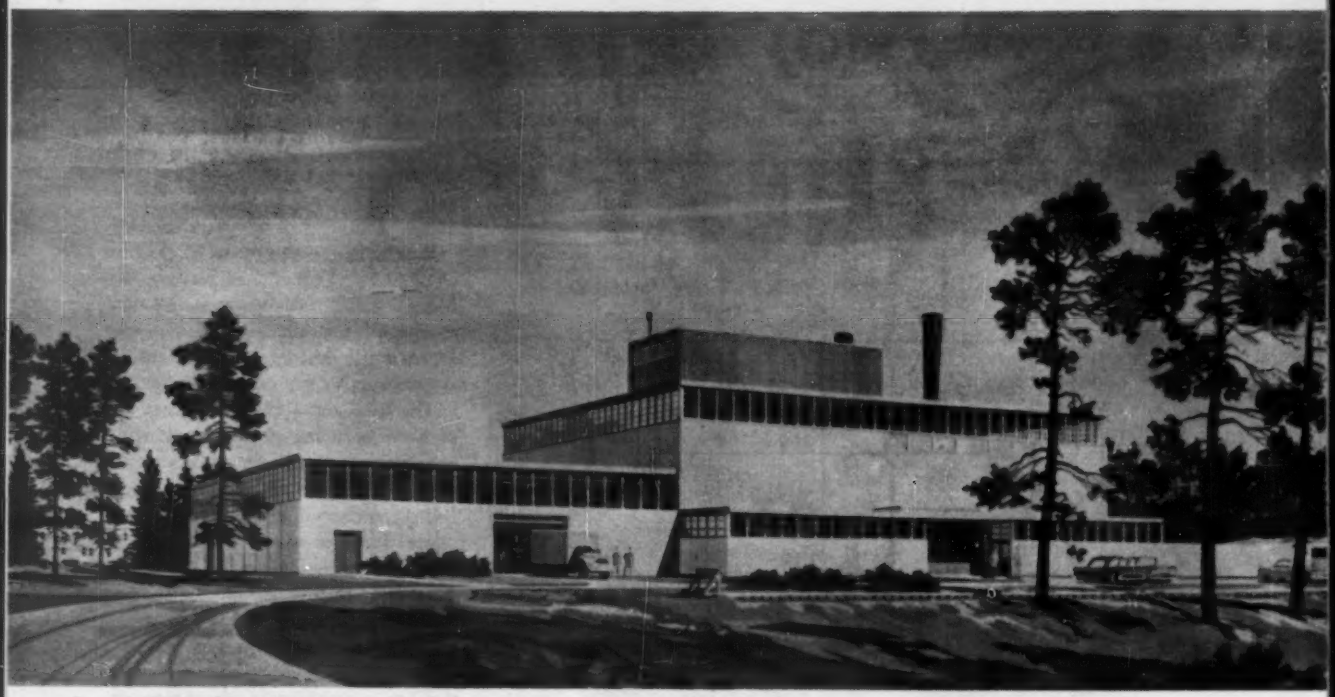
Fig. 7 shows the flexibility of an automatic-extraction-admission condensing turbine. Unit automatically responds to variations in steam needs in a 200-psig system. Horsepower shaft output is the same, 6000 hp for each condition. In the first diagram the turbine governing system acts automatically to extract 100,000 lb per hr as needed in the 200-psig system and pass an additional 28,000 lb per hr to the condenser to maintain shaft output. In the second diagram, steam use and supply in the 200-psig system is balanced from other sources so the turbine automatically changes to straight-condensing operation with zero extraction or admission. Third diagram shows how the turbine works under automatic admission when the 200-psig system has an excess of steam above actual process requirements.

Turbine performance. Fig. 6 shows two automatic-extraction turbines, one condensing and one noncondensing, supplying process steam at three different levels. Note that the system needs only one condenser.

The two extraction turbines, the pressure-reducing valves and spill-over valve between the 200- and 50-psig systems give wide operating flexibility. A drop in demand for 15-psig steam initiates action to close the 50 to 15 reducing valve. If we reduce the 15-psig steam load some more after the Prv flow drops to zero, the governor on the 6000-hp automatic-extraction noncondensing turbine automatically decreases exhaust flow to the 15-psig system and raises the 200-psig extraction flow.

If there is no concurrent increase in demand for 200-psig steam the pressure rises above 200 psig. The 200 to 50 Prv, acting as a spill-over valve, dumps steam to the 50-psig system causing the 7000-hp automatic-extraction condensing turbine to reduce its extraction flow and raise exhaust flow to the condenser as needed to control pressure in both the 200- and 50-psig systems and maintain the required horsepower shaft output. Automatic action of the reducing valves and turbine controls continuously adjusts for swings in demand for process steam and shaft power.

Applications. Availability of steam turbines made from proved component parts and custom designed to meet specific needs has made them the workhorse of the process industries. Simplicity, inherent operating flexibility and governing ease of the steam turbine have simplified the process-engineer's job in the field of automation. Turbine governing can be arranged to respond to the signal from any process variable that should be controlled. When planning a new process or modernizing and expanding an existing one, be sure to use the steam turbine's many capabilities for an economical overall system.

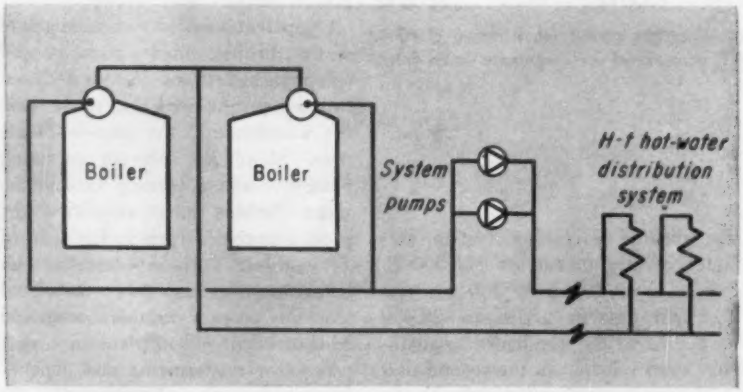


CENTRAL HEATING and power plant, Ernest Harmon Air-Force Base in Stephenville, Newfoundland, presently supplies h-t hot water to heating system from modified steam boilers. Future system's direct-contact heaters will use steam extracted from turbines

Harmon AFB will be first installation where...

Auto-extraction condensing turbines

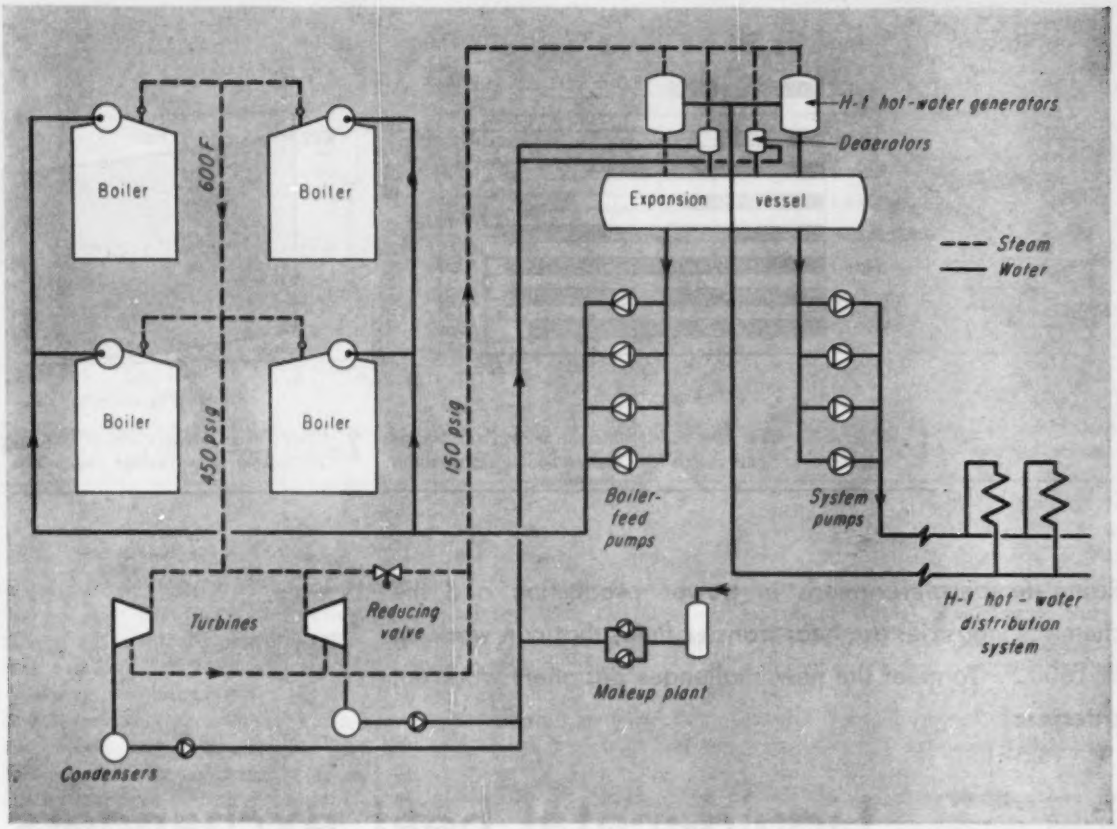
By E G HANSEN and N E PEARSALL*



"GHOST" INCREMENT is presently operating with a connected heating load of only 18,000,000 Btu per hr. It serves two 6-story dormitories, mess hall and dental clinic

In Nov 1958, Ernest Harmon Air-Force Base in Stephenville, Newfoundland started up its "ghost" increment of the new central heat and power plant. With next increment, planned for spring of '61, plant will be first in Western Hemisphere to generate h-t hot water for district heating with turbine-extraction steam. Schematic, left, shows what's in operation at present: two boilers, two h-t hot-water circulating pumps and makeup plant. Expansion tank with hot-water generators and deaerators was omitted. Steam boilers are used as hot-water generators at 150 psig, 365 F, with special baffles and noz-

*E G Hansen is Manager, Superthern Dept, J O Ross Engineering Div, Midland-Ross Corp, N. Y. N E Pearsall is Mechanical Engineer, U.S. Army Corps of Engineers, Eastern Ocean District



FINAL SYSTEM'S four boilers will supply steam to turbines at 450 psig, 600 F. Extraction steam at 150 psig to direct-contact heaters and deaerators provides water for district heating. With turbines down, boiler steam bypasses through reducing station

drive h-t hot-water heating system

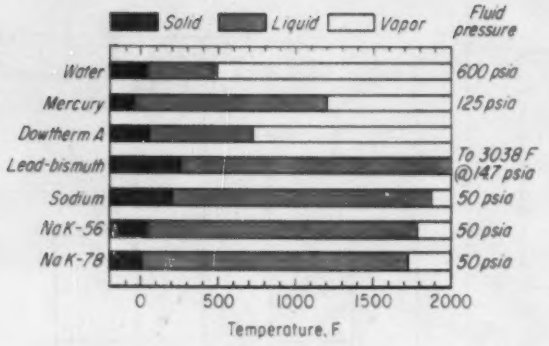
zles in the top drum. System pumps take suction from and discharge to this drum which serves as expansion tank as well as furnishing steam (above water line) for fuel atomization and sootblower.

Future expansion will step up plant, above. Any of four boilers will supply steam to turbine header or reducing-valve station at 450 psig, 600 F. Under maximum rated conditions about 105,000 lb of steam per hr at 150 psig can be extracted from each turbine for heating. This goes to two cascade heaters and two deaerators above a storage tank. A pressure-reducing station bypasses turbines, adds to or replaces extraction with boiler steam when more heat is needed. Condensate and necessary makeup are pumped to deaerators, heated by extraction steam.

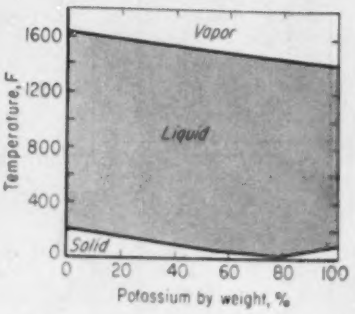
Storage tank takes heated water and condensed steam by gravity from the cascade heaters and deaerators. Pumps circulate h-t hot water through distribution system, then back to cascade heaters to repeat the cycle. Boiler-feed pumps draw from storage tank, completing their cycle via boilers, turbines and pressure-reducing station. This tank serves dual purpose: heating-system expansion vessel and boiler-feed reservoir.

At present, makeup goes directly to boiler drums. Recorders start pumps when drum level drops to predetermined point. In the future these recorders will control valves at the drums to regulate feed from expansion tank; 3-pen recorders which now record only flue-gas temperature will also cover steam flow. Then both water level and steam flow will control makeup. Third pens will record steam temperatures. Drum-level recorder presently also operates at high level to admit cold water to overflow pipe and to open overflow valve and discharge water to blowoff tank. Future system will have continuous blowdown into expansion tank.

Final system is designed for a maximum output of 4000 kw and 200,000,000 Btu per hr. Boilers are 2-drum bent-tube, each having a nominal capacity of 60,000 lb steam per hr at 450 psi, 600 F. Due to conservative design criteria used for remote military bases, there's ample capacity in boiler to continuously generate 75,000 lb per hr without exceeding guaranteed capacities.



1 Heat-transfer fluids have widely different melting and boiling temperatures; liquid metals have highest boiling temperatures



2 Phase-change temperatures of NaK alloy depend on percentage composition

Rising temperature needs in power production and the chemical industries use heat-transfer fluids that can work up to 1600 F. To meet the new challenges designers work out criteria of . . .

Liquid-metal heat exchangers

By ROBERT A TIDBALL, The Griscom-Russell Company

The ideal heat-transfer fluid for high-temperature service would have: (1) low melting point (2) low vapor pressure at high temperature (3) high specific heat (4) low viscosity (5) density about that of water (6) high thermal conductivity (7) low corrosion tendency (8) low chemical activity (9) low cost and (10) commercial availability. When used in nuclear reactors this fluid should also have: (1) low neutron-capture cross section (2) short half life of isotopes generated in core (3) very low decomposition rate under radiation.

Fluids that meet some of these criteria include: mercury (Hg), sodium (Na), sodium-potassium alloy (NaK), lead-bismuth alloy (Pb-Bi) and lead-bismuth-tin alloys (Pb-Bi-Sn). We'll deal with Na and NaK in this article. Information has been abstracted from the *Liquid Metals Handbook* published by Atomic Energy Commission and the Department of the Navy; book can be ordered from the Government Printing Office, Washington, D.C.

Metal properties. Fig. 1 compares the phase-change temperatures of several heat-transfer fluids at specific pressures. While a low melting point is desirable, properties like corrosion tendency, specific heat, density and viscosity may be more important economically.

Melting temperatures above ambient complicate design and operation. Preheat systems must be installed and transient thermal stresses during preheat operations considered. Low vapor pressures of the liquid metals offer important advantages.

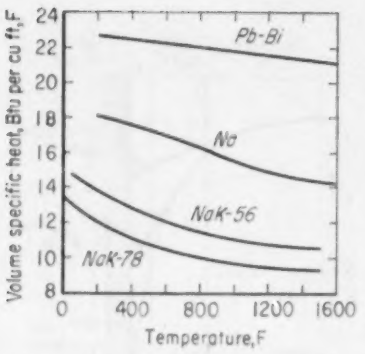
Fig. 2 shows how alloying percentage composition affects phase-change temperatures of NaK.

Specific heat of a fluid helps determine the quantity that must circulate to carry a given heat load. This affects piping and pumping costs. The liquid metals have a much lower specific heat than water at a nominal 1.0 Btu per lb, F; for Na it ranges over 0.30 to 0.33; for NaK-56 (56% K) it is 0.23 to 0.26 and for NaK-78 it drops to 0.21 to 0.24. Hg and Pb-Bi alloy have the lowest at 0.03 Btu per lb, F.

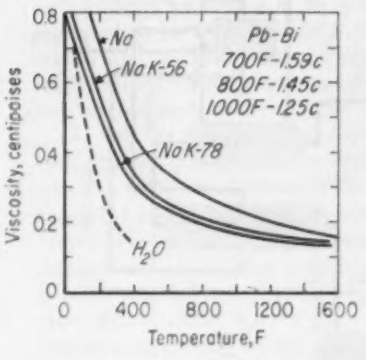
Important in fixing pipe size is the volume specific heat, Fig. 3. Metal specific heats run considerably below water's volume specific heat of about 62.4 Btu per cu ft, F, at normal room temperatures.

Viscosity, Fig. 4, plays an important part in fixing pumping needs. At equal temperatures, viscosity of the alkali metals is higher than that of water, but of the same order.

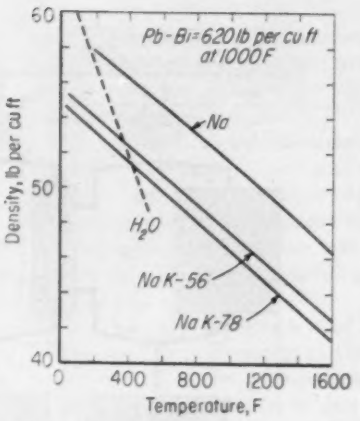
Density, Fig. 5, of the alkali metals runs about the same order as water. But Pb-Bi has a density of 620



3 Volume specific heat of liquid metals is lower than that of water, 62.4 Btu



4 Higher viscosity of liquid metals affects heat transfer and pumping needs



5 Densities of Na and NaK are of same general order at the lower temperatures

lb per cu ft at 1000 F. This makes its pumping cost very high even though it has a high volume specific heat, Fig. 3.

Thermal conductivity of the liquid metals is superior to water, Fig. 8, an overall advantage. But high conductivity can cause trouble during transient thermal conditions.

Fluid choice depends on specific conditions to be met. Na has more favorable heat-transfer properties than NaK with higher thermal conductivity, specific heat and density; higher viscosity is a disadvantage.

Na needs smaller heat exchangers, piping and pumps for a given heat load. NaK, however, with a lower melting point often eases operation by eliminating a preheat system. NaK offers advantages for systems running intermittently or needing frequent draining and charging.

Low K in NaK alloy is desirable since K is more expensive than Na. Density, specific heat and thermal conductivity of the lower potassium alloys also offer advantages. Less than 55% potassium content, however, precipitates sodium on freezing and the NaK must be heated to over 207 F to assure melting. Use NaK-56 for systems heated to 50 F or higher, NaK-66 for above 32 F and NaK-78 for below 32 F when these systems are not running.

Both Na and NaK must be isolated from oxygen, water and its vapor and halogenated hydrocarbons to prevent violent chemical reactions. When above 200 F these metals will ignite on contact with air. The flame and combustion products will severely corrode structural materials.

Cover gases of low oxygen and water content will minimize formation of oxides that obstruct flow and corrode materials. Oxides that form can be removed by cold trapping.

All equipment should be designed to minimize liquid-metal-water reactions and to contain any reaction products formed by accidental leakage. If carbon tetrachloride, trichloroetheline or Freon are used for leak testing or degreasing in equipment, they must be thoroughly removed before charging the apparatus with Na or NaK.

Construction-materials selection depends on several factors: (1) resistance to thermal shock (2) creep and rupture properties (3) corrodability (4) availability of shapes (5) fabricating difficulty.

Thermal shock (thermal stress fatigue) poses a serious problem in designing liquid-metal heat exchangers. Fig. 7 shows the lower temperature gradient in liquid metals compared to other fluids of higher Prandtl number. Heat transfer by electron motion in metals added to the transfer by eddy diffusion and molecular momentum experienced in fluids accounts for higher heat transfer in liquid metals.

Wall temperature runs close to the liquid-metal temperature and during temperature transients wall temperatures change faster than with conventional fluids. In nuclear reactors, for example, fast temperature changes during scrams can make wall stresses exceed material's yield point.

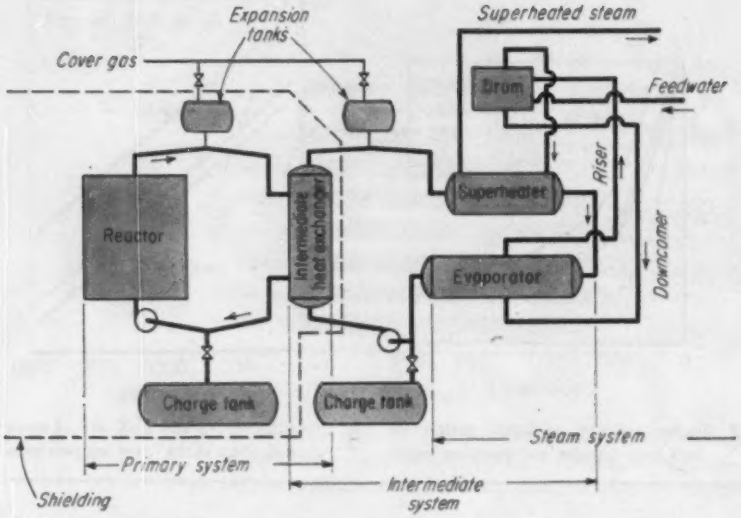
No clear-cut method of evaluating wall stresses is available. Cyclic transient conditions producing fatigue failures are a greater problem in liquid-metal systems than thermal shock.

Where: (1) metals will experience repeated severe thermal stress (2) reliability is important and (3) metals of different thickness must be joined, be sure that changes in thickness are gradual and available nondestructive tests assure joint soundness.

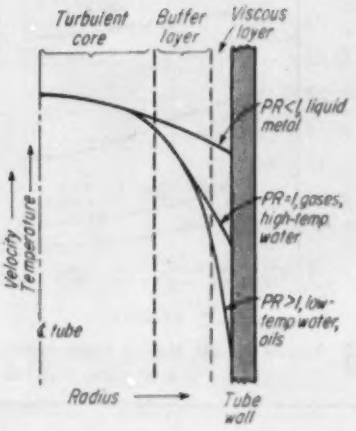
Corrosion of materials by Na and NaK depends on impurities such as oxygen, carbon, hydrogen, calcium and nitrogen that the liquid metals may contain. Oxygen is the most important impurity. It gets into the metal from: (1) mill and welding scale on interior surfaces (2) oxygen or water in the cover gas (3) inward leakage of oxygen or moisture (4) air admitted during maintenance operations.

A wide variety of structural materials may be used when the oxygen concentration is kept below 0.005% by weight. This can be done by cold trapping which uses a bypass to cool part of the liquid-metal flow, pass it through a packed chamber where the oxides deposit as crystals, and return clean metal to the system.

Carbon can enter liquid metals



6 Liquid-metal-cooled nuclear reactor uses two heat-transfer loops to isolate the radioactive loop flowing through core from the feedwater-steam loop of the turbine



7 Temperature drop through liquid metals is smallest of heat-transfer fluids used

from oils and greases left in the system prior to charging or because of improper lube during operation.

Materials suitable for liquid-metal exchangers include carbon steel, chromium-iron alloys, chromium-iron-molybdenum alloys, austenitic stainless steels, nickel and high-nickel alloys and super alloys over various temperature ranges. Permissible temperatures depend on the elevated-temperature properties rather than corrosion rates.

Material availability. Many materials excellent for liquid-metal service are not available in the needed sizes and shapes. Codes are needed to establish allowable stresses for some. Others with superior properties cannot be formed into needed shapes such as seamless tubing, or maximum tube length may limit exchanger design.

Suitable fabricating and inspection techniques must be developed for each material. Welding techniques and inspections used must be considered when choosing materials.

Preheating. Heat exchangers using Na must be preheated prior to charging and should be held above 208 F during downtimes when the Na has not been drained.

Sodium contracts on freezing, so it doesn't damage equipment. But great care must be taken during remelting to prevent damage. Sodium must be melted from a free surface, such as the expansion tank outward to the system. Vessel heads and pipe fittings have ruptured when sodium systems were remelted carelessly.

Most operators keep the system hot with the preheat apparatus during shutdowns when the system is not drained. NaK exchangers do not need preheat unless system must be charged when the ambient temperature is much below NaK's freezing point.

Minimum safe charging temperature depends on Na temperature in the charge tank, charging rate of Na, heat capacity of system components and allowable stress during charging. Thermal stresses during charging can be severe if the preheat temperature is not controlled.

Preheating rate is important in large Na heat exchangers. Permissible preheat rates for one sodium-heated steam generator were:

(1) Dry	3 F per hr
(2) Water in shell, dry tubes	20 F per hr
(3) Water in shell, Na in tubes	100 F per sec
(4) Normal operation	200 F per min

Preheat rates of 50 to 100 F per hr are feasible in some designs.

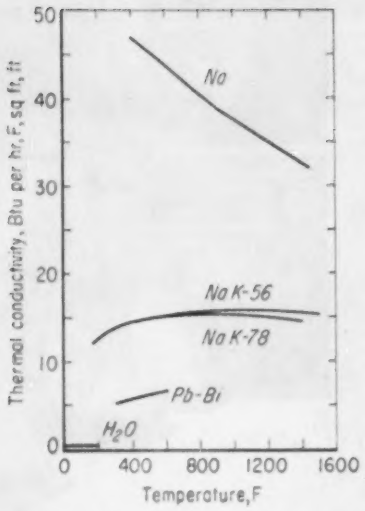
Electrical resistance heaters fastened to the outer surface of heat exchangers usually preheat them. These can be tubular heaters, strip heaters, asbestos-insulated resistance wire and "clamshell" heaters. The type chosen depends on maximum preheat temperature needed, maximum operating temperature, permissible preheat rate and temperature variation within a component during preheating.

Na heat exchangers can also be preheated by the fluid to be heated or cooled. In Na-to-gas exchangers hot gases can preheat the surface. The gas can be heated electrically or by installing a small gas burner in the inlet line and letting flue gas flow through the exchanger.

Maintenance. The liquid-metal side of heat exchangers should be opened only for repair of structural failure or plugged tubes. Scaling or fouling of the liquid-metal side of tubes has never been found.

Before opening, drain the exchanger completely. This reduces hazard to personnel, eases cleaning, and where radioactive Na-24 may be present accelerates the decontamination operation. For major repairs any residual sodium can be removed by passing a chemical reactant, such as methyl or ethyl alcohol, dry steam or humid inert gas through the exchanger. After all the free liquid metal has been reacted to form the hydroxide, methylate or ethylate these are removed by water rinsing.

When possible and economically



8 Thermal conductivity of liquid metals aids their usefulness in heat transfer

practical, the exchanger should have a minimum of hard-to-clean crevices. The Na or NaK should be in the shell rather than in tubes and the exchanger and tubes should be sloped for draining. Latter two points are often bypassed since placing liquid metal in the shell increases liquid-metal inventory and sloping tubes within a horizontal shell is impractical in the most stress-free design. These disadvantages have been overcome by compartmenting tube side of the exchangers into several parallel passages to lower the holdup in individual tube bundles and to make tube-bundle replacement economically possible.

Preventing leakage. In liquid-metal-heated steam generators great care must be taken to prevent interleakage of the metal and water. In nonradioactive applications feasible designs can be made to withstand sodium-water reactions and use single-wall barriers between the liquid metal and water.

In primary coolant circuits of nuclear reactors that may contain radioactive Na-24, it's necessary to have double wall barriers between liquid metal and water in the steam generator. Double tube sheets with double-wall tubes and an intermediate monitoring fluid may be used.

Some reactors use two fluid loops with an intermediate heat exchanger for transferring heat from primary loop through the reactor to an intermediate loop through the steam generator, Fig. 6. This system uses an extra heat exchanger, pump and piping but has several advantages.

(1) Intermediate heat exchanger, much smaller than a steam generator, runs at lower thermal stresses without danger of water corrosion. Pressure drop of the radioactive fluid passing through shell side of the exchanger is lower and reduces size of the primary pump. This type of primary coolant system, being smaller than the single-loop system, reduces size of reactor compartment and shielding.

(2) Intermediate fluid does not pass through the reactor and does not become radioactive, so the steam generator need not be inside the shielding and can be inspected in operation.

(3) Several steam generators can run in parallel on separate systems. Trouble on one generator contaminates the intermediate fluid but not the primary fluid; one generator can be shut down without shutting down the entire plant.

Disadvantages include higher total liquid-metal inventory even though amount of radioactive liquid metal is reduced; additional apparatus needed such as intermediate heat exchanger, pumps, charging tanks, piping; extra pumping raising operating costs.

Single-loop system passing radioactive liquid metal through the double-wall-tube steam generator has the advantages of: (1) less equipment and lower cost (2) lower pumping cost (3) lower liquid-metal inventory.

On the debit side: steam generator must be in shielded area; larger reactor compartment is needed; maintenance is more difficult—simple repairs might require complete draining and flushing of liquid metal.

Fabrication, inspection. Some industries use Na and NaK as chemical-reactor coolants at temperatures of 100 to 400 F. These exchangers, designed according to applicable codes, are fabricated of carbon steel to sound commercial standards.

Other exchangers for temperatures above 1500 F need special quality materials, fabricating techniques and stringent inspection. Specifications should be written in accordance with the severity of the operating conditions and the same engineering judgment applied as for a high-pressure high-temperature steam system. Some general rules are followed for high-temperature liquid metals.

(1) All joints are welded—tube-to-tube-sheet joints, shell and channel closures and nozzle connections. Flanges have been used successfully, but the cost of repairing one leak is greater than cutting and rewelding a similar joint many times.

(2) Seal weld closures backed by bolted pressure plates are good where repeated penetration is anticipated.

(3) Tubing for critical service be subjected to an unusual number of nondestructive tests — ultrasonic inspection, hydrostatic, dye penetrant —and for most severe service, a pressure-twist test.

(4) Forgings should be inspected ultrasonically.

(5) When joining pieces of varying thickness, the change in thickness should be gradual.

6) Welds should be inspected with dye penetrant at the root pass and final pass; when possible radiograph them. If that's impossible, extra dye-penetrant tests should be made after intermediate passes.

(7) Backing rings should be removed after welding, when possible, to eliminate crevices and stress risers.

(8) Consumable insert welds and inert-gas backed welds without backing rings are acceptable.

(9) Heat exchangers should be free of dirt, oil, grease and other matter after fabrication. Parts which cannot be inspected in the final assembly should be cleaned previously.

(10) Completed heat exchanger must be leaktight. We have no quantitative measure of the maximum acceptable leak, but use these rules: (a) Mass-spectrometer leak detector shall not show more than 0.05-micron cu ft per hr (b) Freon leak detector shall show no leak. The system must be very dry prior to the leak test to prevent forming very corrosive hydrofluoric acid. All Freon must be removed after the test to prevent chemical reaction between Na or NaK and Freon on charging.

(11) Completed exchangers should be sealed immediately to prevent internal dirtying during storage, shipment and installation. Exchangers are often shipped under 2- to 5-psig pressure of inert gas internally.

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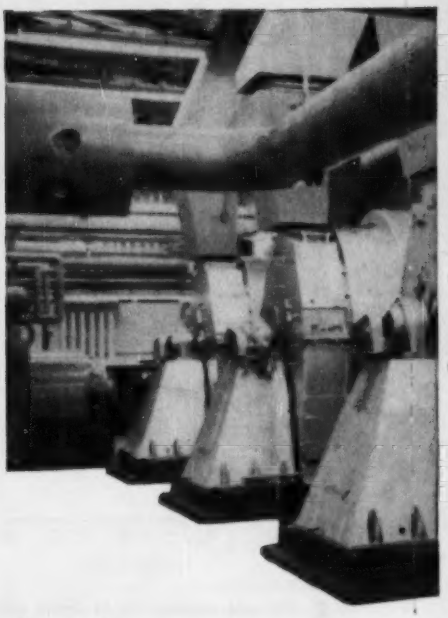

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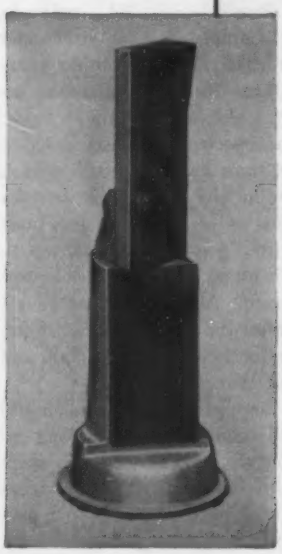
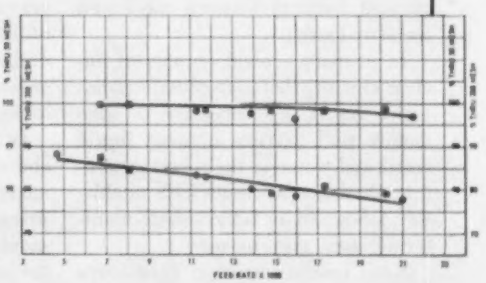
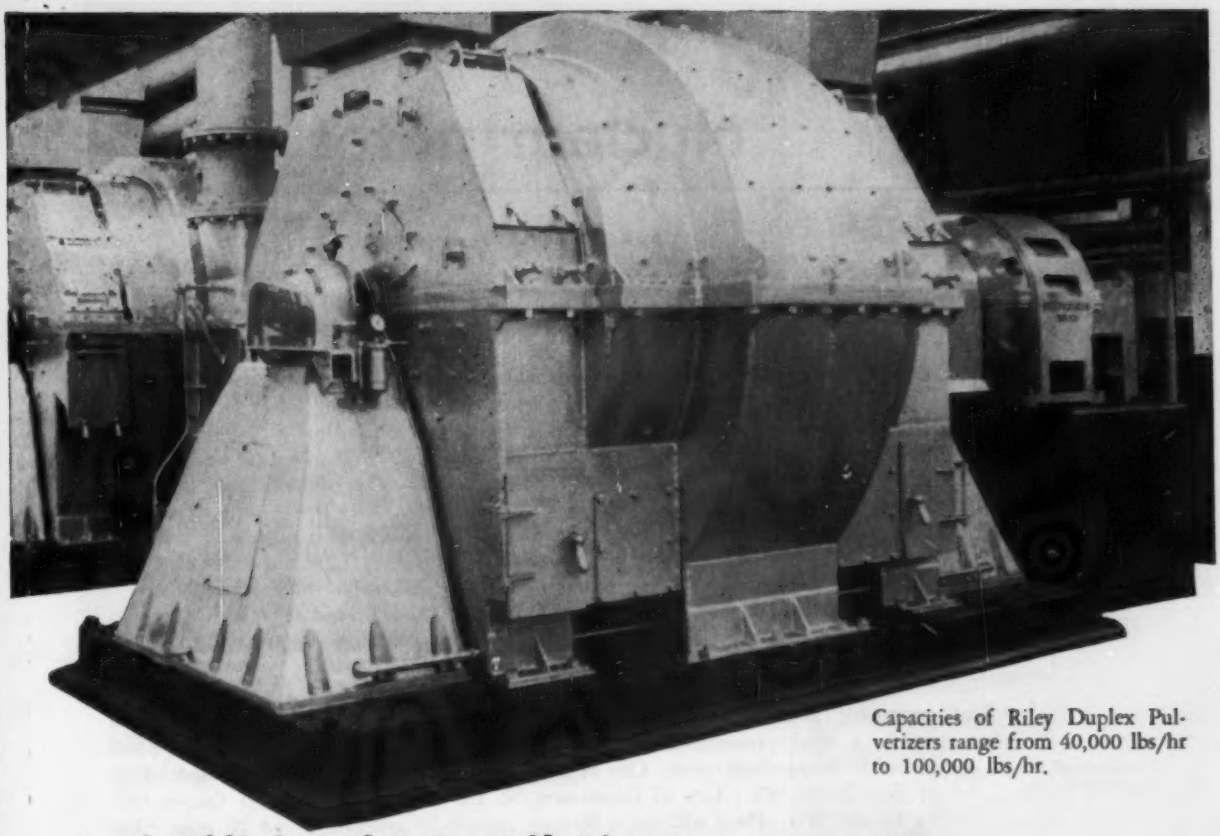


At left is a typical pulverizing element faced with high grade erosion resistant tungsten carbide. At right are the results of fineness test conducted on a duplex type pulverizer. Test #1 ○ before elements were replaced; test #2 □ after new elements were installed. Results show no appreciable drop in fineness and capacity in either case.





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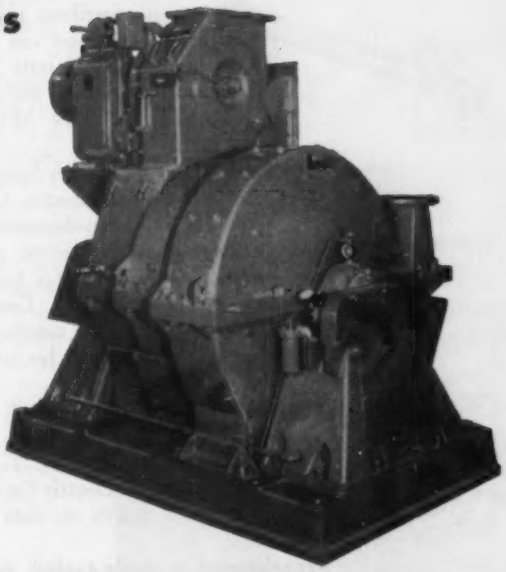

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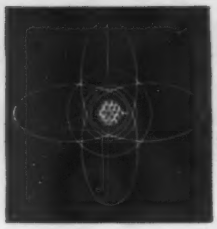


Nuclear notes

By B G A SKROTZKI, Associate Editor

AEC invites proposals for two prototype nuclear plants: (1) boiling-water reactor and (2) organic-cooled and -moderated reactor. As part of the Power Demonstration Reactor program each type should have a minimum capacity of 50 mwe. Privately, publicly and cooperatively owned utilities may submit proposals, due sometime in April—exact date to be announced. Proposers would be expected to design, build and run the entire plant. AEC will support research and development and waive fuel-use charges during first five years of operation. The organic reactor will run with forced convection and produce steam at 600 F or higher. Uranium oxide clad with sintered aluminum powder is expected to raise allowable fuel-surface temperature to greatly increase fuel burnup. Industry is also invited to submit proposals to design, develop and build these reactors. If no acceptable proposals are received the AEC intends to proceed with building these plants itself.

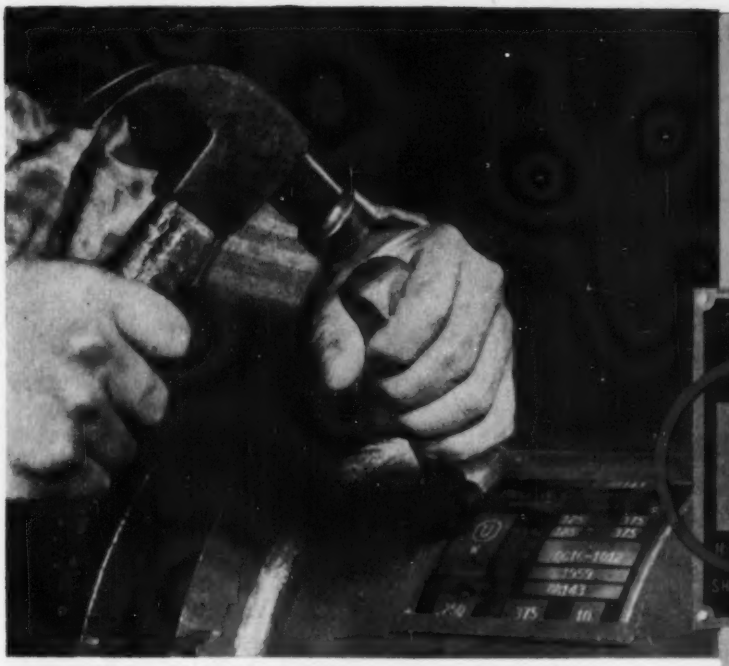
Five proposals were received by the AEC from cooperatives and public power groups to run a small pressurized-water nuclear plant that the AEC is designing and plans to build. Respondents were: City of Miamisburg, Ohio; City of Detroit, Mich.; City of Fort Pierce, Fla.; City of Jamestown, N. Y.; and Dairyland Power Cooperative, La Crosse, Wis. Plant will use a 60-mwt reactor to generate about 22 mwe. The utility must contribute plant site, turbogenerator plant and associated buildings and services; it also must run the plant, train personnel and buy the steam from the AEC. Construction starts June 1960 with a target date of August 1962. Gibbs and Hill, Inc is designing the steam-producing part of the plant. Reactor-builder proposals are due at the AEC on February 1, 1960.

Big Rock Point Plant on Lake Michigan, proposed by the Consumers Power Company and the General Electric Company, has been submitted to the AEC to be considered for joint development. The 50-mwe plant will use a boiling-water reactor with a substantially increased power output per unit volume of fuel. Fuel elements would be developed for long life and low fabrication costs. Plant capacity may ultimately rise to 75 mwe. Consumers Power would pay all costs of plant and its operation; plant can be running by late 1962 at a cost of over $27 million to them. Bechtel Corp would be architect-engineer.

Reprocessing costs — what will they be? Five utilities aim to find out by engaging Davison Chemical Company to study the question. Commonwealth Edison Co, Consolidated Edison Co of N. Y., Inc, Detroit Edison Co, Northern States Power Co and Yankee Atomic Electric Co expect to spend about $250,000 to find the answer. Study will rely primarily on data in the technical files of the AEC.

Experimental organic-cooled reactor proposed by the Fluor Corporation as architect-engineer is being considered by AEC. Atomics International, as subcontractor to Fluor, will assist in designing the reactor. It will be built at the National Reactor Testing Station near Idaho Falls, Idaho. Phillips Petroleum Company made the conceptual design. Builder and operator will be selected later—Congress has appropriated $6 million for the test facility.

Nuclear Power Demonstration project of Canada has reached the half-way construction mark. The 20-mwe plant will cost about $32 million and is scheduled to start in mid-1961. The pressure-tube reactor uses natural uranium for fuel and heavy water as both coolant and moderator. Plant will feed Ontario Hydro System.



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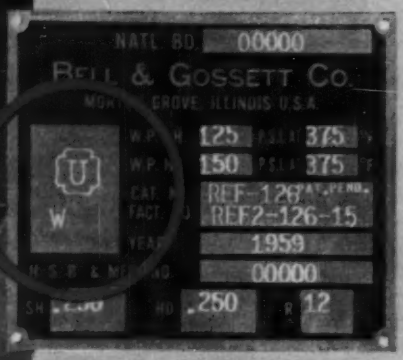

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For more facts circle 236 on Reader Service card, p 117

Reserved for your comment

BOB BELLAS, Associate Editor

Sounding board

My congratulations to George Edwards on his article, *Why not standardize OE exams* (Dec 1959, p 194). As a member of an examining board governing license issue to stationary engineers, I have long recognized the need for qualifications standards for each license grade.

Couldn't POWER organize a group to compile a book of questions and answers covering all phases of plant operation and maintenance? Then make the book available to the public, cities and states having license laws. Such a book would help us all, cities and states, to gradually standardize our examinations with a minimum of confusion.

We are all faced with the problem of revising our examination questions periodically. A book such as I suggest would be of real help.

E A BARBLES, *Brown-Bellows-Smith, Inc Houston, Texas*

. . . Basically, George Edwards' idea is an excellent one. Steam is steam, a refrigerant is a refrigerant and an engine is an engine. Stationary engineering on the whole is much the same around the world. It is application and local needs which vary the situation and should have recognition in local examinations.

A Code boiler is installed, inspected and repaired in the same manner in all Code areas. Engineering fundamentals are the same. Applications vary and determine methods. Example: In New York City buildings go up in the air and down in the ground. In the City of Tampa the majority of plants are 1-story, cover acreage on sandy, porous soil; a few have 1-level basements.

Weather conditions, chemistry and availability of water, length of pipe runs, building and equipment foundations, sewerage, type and size of machinery installed and numerous other factors all affect the local requirements for knowledge and experience of an engineer. It's my opinion that if, say, 80% of the OE exam could be standardized on a national basis with remaining 20% allowing for local conditions, all concerned would benefit with a minimum of lost working time, shutdowns and bad tempers.

D C MCCLELLAND, *Boiler Inspector City of Tampa, Fla.*

. . . I must take exception to some of George Edwards' remarks. Having worked under several license laws, domestic and foreign, I can't believe that a chief engineer's license is easier to obtain in one state than a fireman's in another.

Engineers are licensed to protect lives and property and it is not only the right but the obligation of a state to pass and enforce rigid licensing laws. It's true that differences exist in engineers' examinations, but this is also true of electricians, motor-vehicle operators, nurses, pharmacists, physicians and, last but not least, professional engineers.

As for the old canard on alleged superiority of marine-engineers' licenses vs stationary, I say it all depends on the man. Any licensing authority must have arrived at its present system on a basis of proved experience, and what is best for its area's needs in the opinion of local examiners.

I believe that an extension of licensing laws to nonlicense areas and rigidly enforcing existing laws would clear things up.

JOHN KING, *Brighton, Mass.*

. . . George Edwards' article is perfect—send me 300 copies of it.

It is an ideal subject; should create much chapter discussion and really start the ball rolling.

F W START, *Vice-Chairman*
Joint Committee on Education and Certificate of Engineering
National Ass'n of Power Engineers, Inc

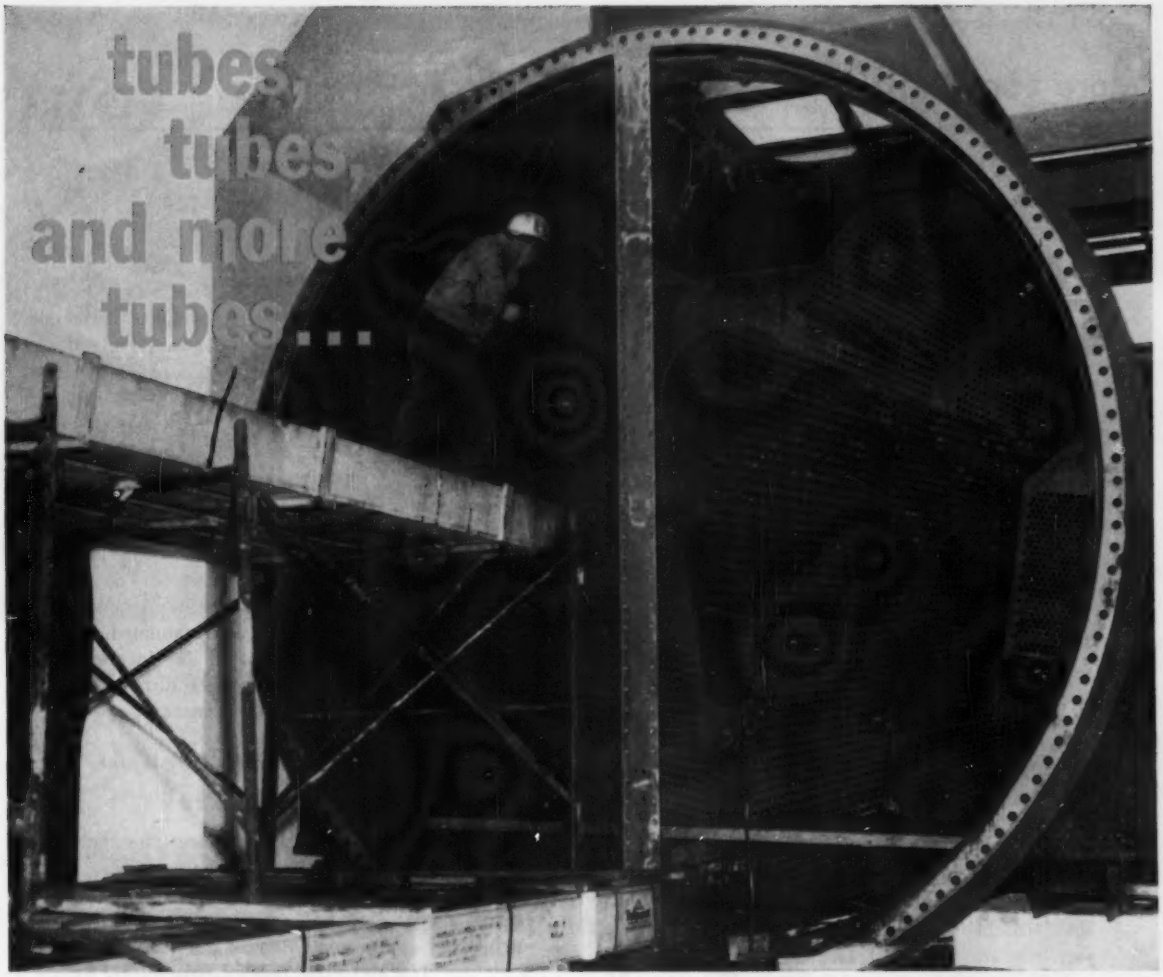
. . . Congratulations and best wishes to George for his sincere effort. As a past holder of several OE licenses in various states in our great country, I can readily see his point and support his contention that benefit of standardization to both engineers and management should be explored.

I believe that a concerted effort on the part of Federal, state and municipal authorities concerned could bring into being a program that would result both in better-trained operating engineers and time and dollar savings for industry as a whole.

CARL BACHMANN, *Jamaica, N. Y.*

. . . It's a loaded proposition—depending on where you stand. I personally would be in favor of a standard method of examination, whether it is a national board or even a federal classification. Scope of requirements should be specific and uniform, just as the Boiler and Unfired-Pressure-Vessel Codes are in their respective areas.

A standard license would permit greater flexibility in obtaining qualified personnel for all organizations, especially those located close to state border lines. It would also let licensed and quali-



City of Lakeland Builds to Last with Bridgeport Condenser Tubes

Tubes by the thousand – all Bridgeport – are used in the 32,500 sq. ft. surface condenser manufactured by the Yuba Heat Transfer Division, Yuba Consolidated Industries, Inc., Honesdale, Pa., and installed in the new Charles Larsen Memorial Plant at Lakeland, Fla. Owned and operated by the City of Lakeland, the plant will generate some 25,000 kw. Designers and consulting engineers – Wellman-Lord Engineering, Inc., Lakeland, Fla.

Tubes chosen were Bridgeport's Arsenical Admiralty type, consisting of 71% copper, 1% tin, 0.03% arsenic, with zinc making up the balance. These tubes offer good general corrosion resistance to most types of circulating waters and give excellent service in sea water at velocities below 6 feet per second. Satisfactory performance is thus assured in power stations on the seaboard as well as on polluted fresh water lines. Biofouling is effectively resisted.

Bridgeport tubes are available in a wide range of aluminum, brass and copper alloys for all types of condenser and heat exchanger application. Bridgeport's Technical Service Department will gladly advise on the tube or alloy best suited to any particular situation. Call your nearest Bridgeport Sales Office for details... or write Dept. 5402.

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For more facts circle 237 on Reader Service card, p 117

fied operators work anywhere in the country without the existing re-examination barriers.

Greatest advantage would be to the Federal Government, especially during periods of national emergency. We would have a pool of specialized skills of a known value based on standardized methods. At the present time this same pool would have to be re-evaluated. There are 50 states plus a number of major cities that can control licenses. To convert all of these would be simply a "guesstimate" of little value.

It's also my opinion that a standardized examination for operating engineers would lift their spirits and result in more pride in their occupation—and that can never hurt anyone.

PAUL NOVITZKI
Plastics and Coal Chemicals Div
Allied Chemical Corp, N. Y.

. . . It is a laudable objective but will certainly take a stupendous effort to get under way.

Need for more uniformly qualified operating engineers is no secret in industry. Recently the Air Force tightened requirements for personnel in large heating and power plants. Done to raise standards of the operating personnel, it's an example, in a way, of what Edwards is talking about.

PERRY KEARNEY, *PE*
Fort Lee, N. J.

Seals can live out of water

If Harold Stamey of Owens-Illinois Glass Co (*Practical ideas,* December 1959, p 214) wants to save even more money, he can take the seal cage out and eliminate the seal water entirely. In a boiler-feed pump the suction is always under a positive pressure—so no air can enter through the stuffing box anyway. This will save the small amount of hp required to pump this seal flow and reduce operating costs.

JOHN PEARSON, *Fair Haven, N. J.*

Watch those leprechauns, too

J Curran of Quebec removed the check valve from his blowdown line (*My biggest boner,* July 1959, p 202). This could be dangerous if more than one boiler blows down to a common line to the blowdown tank. Insurance companies here insist on check valves to prevent possible blowback of steam into a boiler drum where men are working.

A G KELLY
Electricity Supply Board, Dublin, Ireland

Refreshers being served

Are reprints available on the complete series of Associate Editor Skrotzki's *Thermo refresher* articles? I note that the December 1959 issue brings us up to No. 33. Before I realized that this was a continuing series, many of our earlier issues had been destroyed. Only solution seems to be procurement of a complete set of reprints to date. In the event that Mr Skrotzki should contemplate publishing these articles in book form, I would withdraw the request for reprints and await publication of the complete volume for which I would be pleased to invest whatever the price might be.

Editor Skrotzki is to be congratulated on his excellent presentations. I would like to add these articles to my permanent reference library.

T L ZUMBRO, *Regional Engineer*
Engineered Machinery Div
York Corp, Subsidiary of Borg-Warner Corp
Atlanta, Georgia

. . . Please let us know if tear sheets for the complete series are available.

Is it premature to ask if you plan to make this series available in book form or as a POWER reprint, and approximate date of publication?

T J MCCALL, *Supt of Generating Station*
Greenwood Utilities, Greenwood, Miss.

EDITOR'S NOTE: *Above are samples of many such letters we've received since Ben Skrotzki's* Thermo refresher *series began in the August 1956 issue of* POWER. *Here's the dope on its status:*

Copies of installments to date can be supplied at a cost of 5c per page for those who wish to compile the articles in this fashion. We estimate that this series will include 50 parts in all, so they should run for another 18 months. At the end of the series, Ben hopes to republish all of the articles between hard covers. It will probably be another two years before the book becomes available.

Coming next month!

Problems associated with conditioning air for industry are theme of 16-p special report in March issue. Now being written by Associate Editor Lawson Stewart, report covers the many kinds of atmospheres required in industry and techniques available for achieving wanted results. Emphasis throughout is on the practical aspects of design—watch for it!

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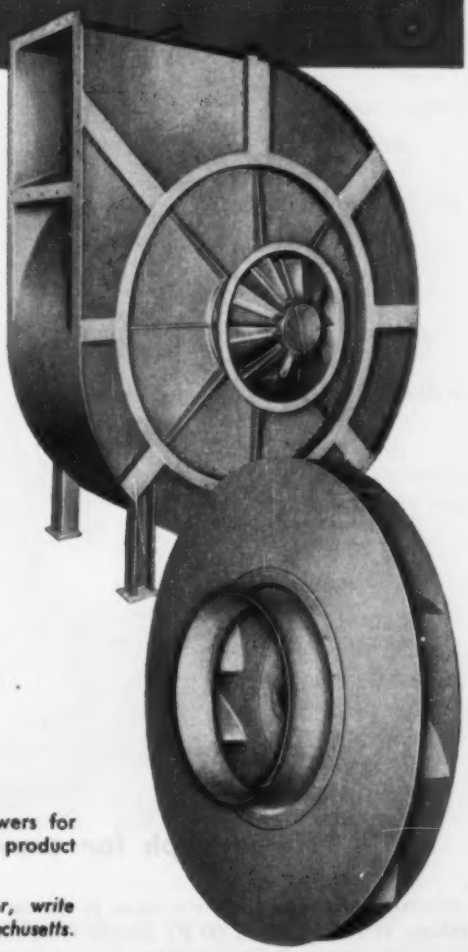

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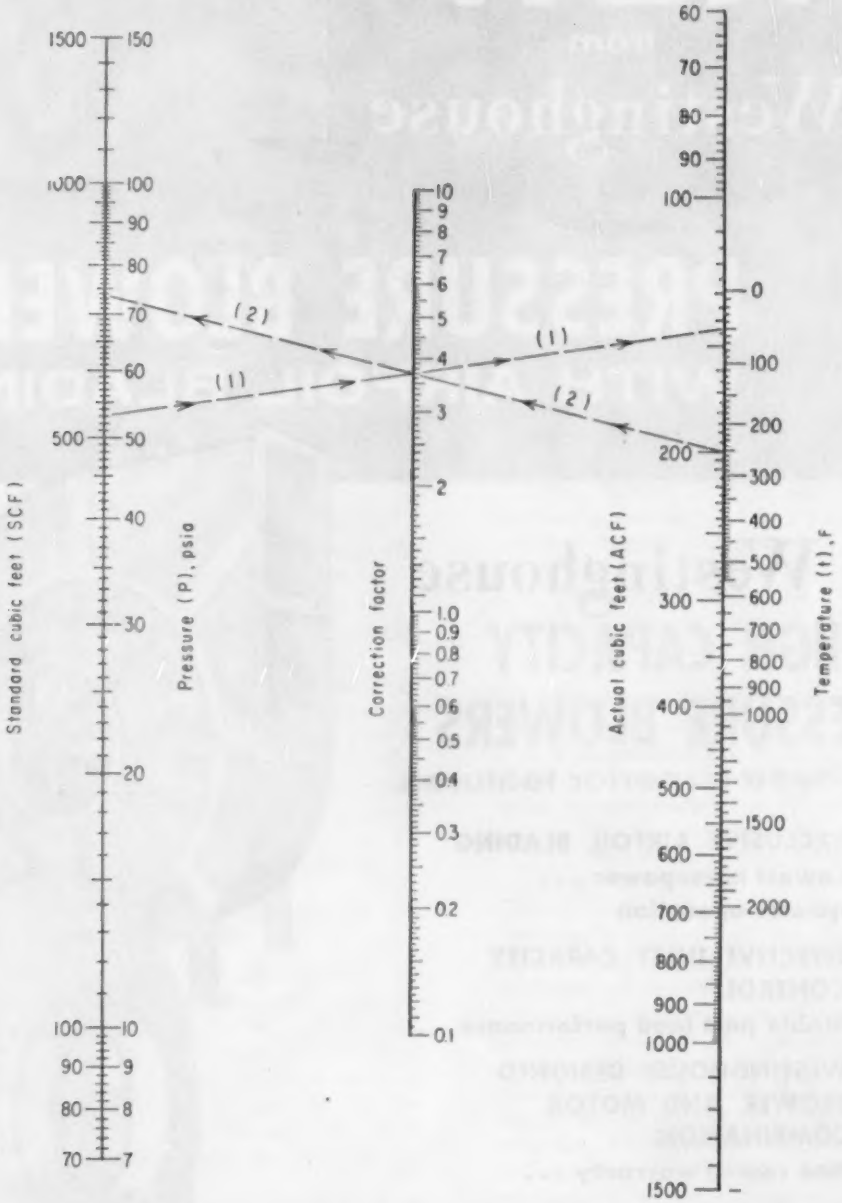
Power's data sheet

No. 330



Nomograph for converting to standard cubic feet

Conversion of gas or free-air volumes to standard cu ft (volume at 14.7 psia and 60 F) evolves from formula:

$$SCF = ACF \times \frac{P}{14.7} \times \frac{520}{(t + 460)}$$

Example: What is *SCF* per min corresponding to 2000 *ACF* per min at 533 psia and 50 F?

Solution: Align $P = 533/10 = 53.3$ with $t = 50$; align intersection of correction-factor scale with $ACF = 2000/10 = 200$ and read *SCF* intersection of 740. For values beyond either *P* or *ACF* scales, scale value is multiplied by *N*, then scale value of *SCF* must be multiplied by *N*. Since both *P* and *ACF* scales were multiplied by 10 final answer is 740x100 or 74,000 *SCF* per min.

F Caplan, *Oakland, Calif.*

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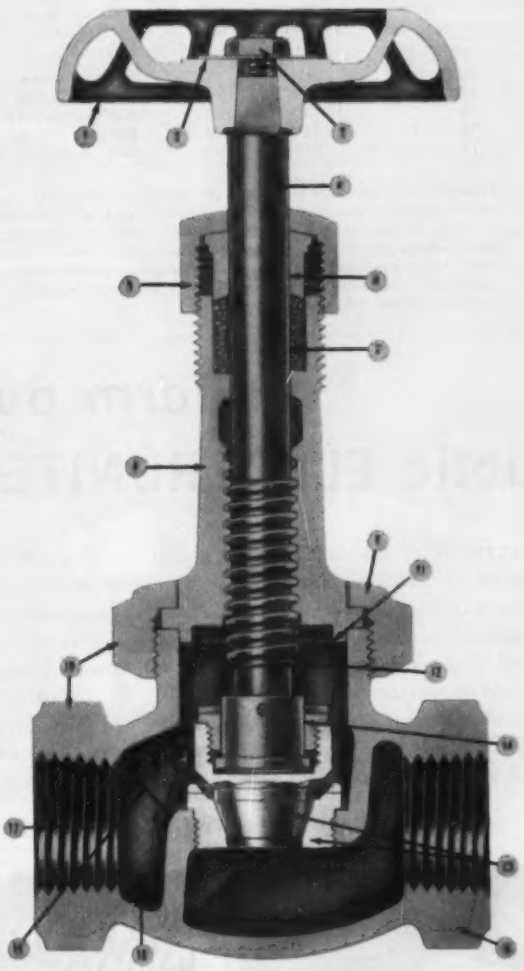

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FARROWTEST REJECT TABLE

Wall Thickness (B.W. Gage)	Minor dimension of the defect (Length or Depth)	Defective Area (Length, Depth Plane)
20	.006"	.0025 sq. inches
18	.006"	.003 sq. inches
16	12½% of wall	.003 sq. inches
14 and 13	12½% of wall	.004 sq. inches
12 and heavier	12½% of wall	.005 sq. inches

FARROWTEST detects and rejects not only tubing containing defects which completely penetrate the wall; but also tubing with defects equal to, or greater than, those shown in this table. For irregular defect shapes, a tube with defect area equal to or greater than shown above is rejectable. Where required, sensitivity of FARROWTEST equipment can be calibrated to reject defects of lesser specified area than shown in table, at extra cost.

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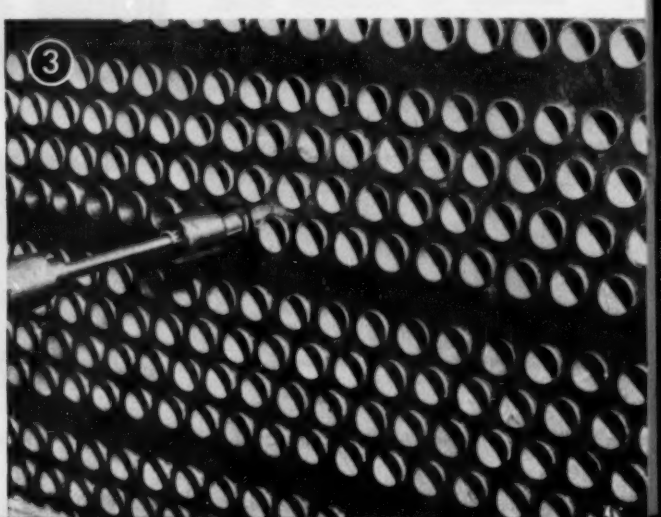

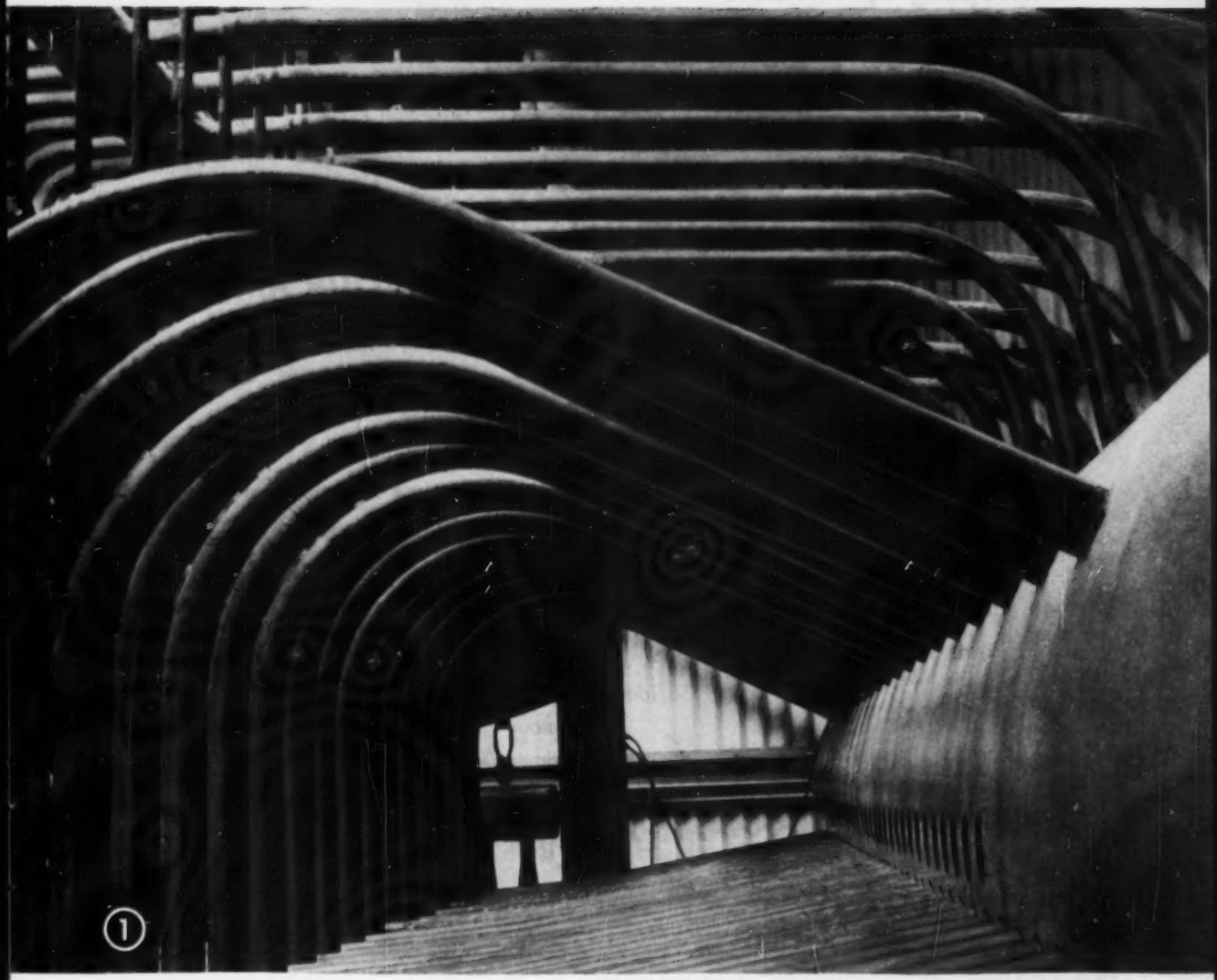

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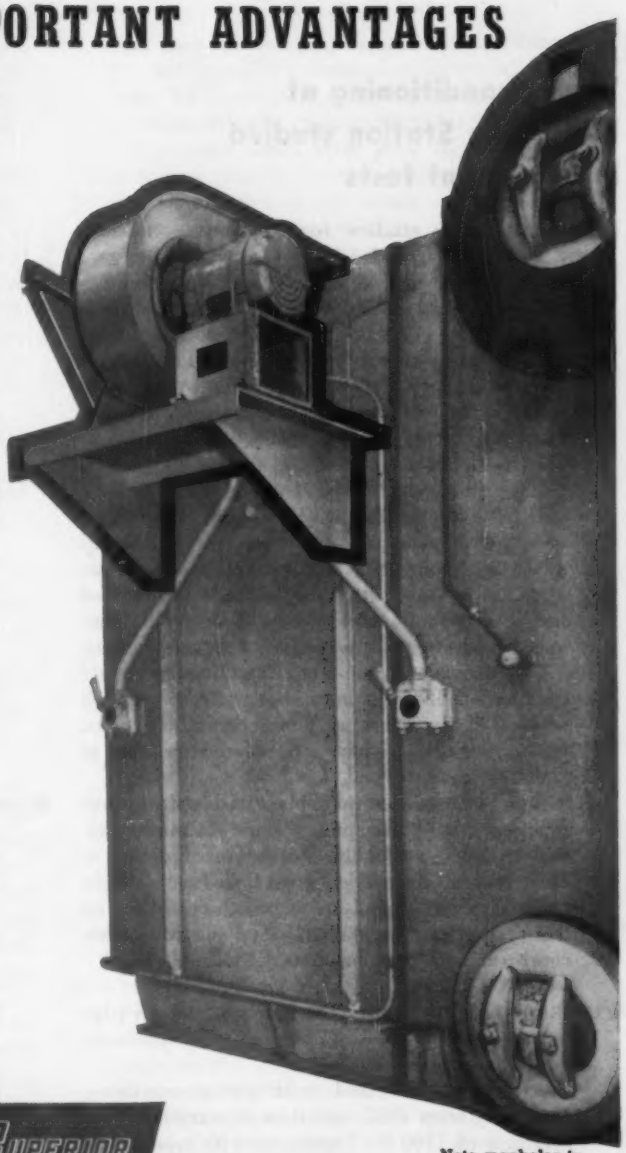

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Technical briefs . . . Latest engineering

Water conditioning at Eddystone Station studied in pilot-plant tests

Pilot-plant water studies for Eddystone Station, *F N Megahan, Philadelphia Electric Company*

Once-through boilers at Philadelphia Electric's Eddystone Station need very high-purity feedwater because design doesn't allow for blowdown.

Anticipating these requirements, Philadelphia Electric ran pilot-plant studies over a 2-year period on a variety of arrangements using several anion-resin types. City water available for makeup contains 110 ppm dissolved solids (as $CaCO_3$).

Early tests used Type I anion resin with a variety of pretreatments. These tests were unsatisfactory; after only 21 runs, conductivity increased to 0.8 micromhos and bed capacity dropped from 10 to 1.5 kg per cu ft. Activated carbon controlled bed fouling only at very low throughputs (two gpm per sq ft) and conductivity kept on climbing.

Both porous and nonporous Type II resins greatly improved bed operation; conductivity stayed well below 0.1 micromhos after more than 200 cycles. But porous-resin volume was reduced by 20% in about 150 runs.

As a result of these pilot-plant tests and previous experience at Philadelphia Electric's Cromby Station, a 2-bed mixed-bed system was installed at Eddystone. It used 8½% cross-linked cation resin and nonporous Type I anion resin. Trial runs on this system have been satisfactory and results are consistent with previous tests. *ASME 59-A-260*

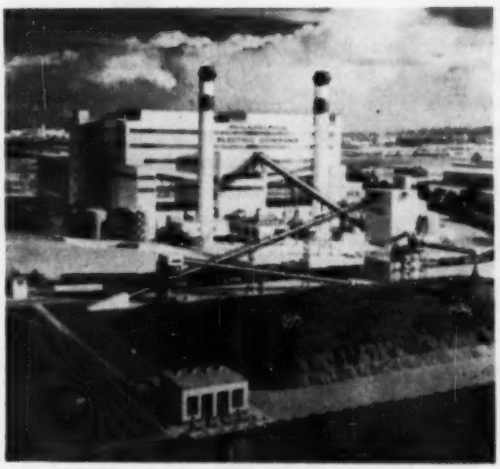
A test to anticipate the performance of steam piping at 5000 psi and 1200 F, *G C Wiedersum, Philadelphia Electric Company*

Type 316 stainless-steel steam-piping experience dates only from 1957, and then at maximum temperatures of 1100 F. Experience with type 347 is greater—since 1948—but again maximum temperatures are less than 1200 F.

Piping tests prior to startup of the Eddystone Station were designed to anticipate difficulties that might later appear in service at 5000 psi and 1200 F. By testing pipe samples at 1225 F a time-acceleration factor of 2.5 was achieved.

Test setup and procedures simulated operating conditions as closely as possible. Special attention was paid to welds since they were trouble areas in type 347. Test-sample temperatures were cycled to duplicate ultimate unit operating conditions.

Periodic inspection of test sample covers (1) ultrasonic tests of the welds to detect cracks (2) micrographs to detect metallurgical changes and (3) checks of runout and diameters to detect creep. *ASME 59-A-230*



PHILADELPHIA ELECTRIC'S new Eddystone Station is on the line. Throttle conditions are 5000 psig, 1200 F

Water-treatment, corrosion and internal-deposit studies for Eddystone, *R C Ulmer, H A Grabowski, R C Patterson, Combustion Engineering, Inc*

Eddystone's ultimate success depends largely on satisfactory steam-generator operation in a previously uninvestigated pressure-temperature range. To study corrosion rates and internal-deposition characteristics, two test supercritical boilers were built—one in Switzerland and one in America. The American test boiler was essentially a model of the Eddystone unit and it operated in a simulated version of the final water cycle.

Each test boiler contained a variety of metals and was rigged specifically to produce maximum test data. Both machined and unmachined test samples were used to show differences in corrosion rates produced by varying surface conditions.

Test data obtained from American and Swiss tests are tabulated and interpreted. Results confirm design and selection of materials for the Eddystone steam generators. *ASME 59-A-147*

Research problems relating to production and quality control of ultrapure feedwater for Eddystone Station, *J A Levendusky and V J Calise, Graver Water Conditioning Company*

Pilot-plant studies of the water-purification arrange-

ment for Eddystone proved adequacy of proposed equipment. Makeup system includes influent filtration, cation and strong-base anion exchangers followed by a mixed bed. In addition, three mixed-bed units treat full condensate flow.

Tests confirmed that filtration is an important part of the purification cycle for removal of suspended solids. Filtration, not ion exchange, reduces Cu and Fe to desirable levels. Results of high-flow-rate runs in test demineralizer plant showed added benefit of pre-filtration in minimizing pressure drop across mixed bed. Also, filtration reduced suspended solids from as much as 60 ppb to about three ppb, substantially lowering solids load on mixed bed.

In event of condenser failure, mixed beds will remove solids and silica effectively and protect critical equipment until trouble is corrected. *ASME 59-A-240*

Nuclear power

Design study of a 300-mw organic-cooled reactor, *B Balent, Atomics International; G H Bosworth and J Plawchan, Bechtel Corporation*

Organic Moderated Reactor Experiment (OMRE) tests lead to design of 300-mw organic-cooled reactor power plant. Attractive design features include: (1) low pressure on the primary system—in the 600- to 800-F range (2) compact core (3) no hazardous reactions with coolant, uranium, fuel or water (4) negligible corrosion rates (5) standard materials and components (aluminum for fuel cladding, low-carbon steel in standard pipes and valves) (6) low induced activity in coolant and (7) large negative temperatures and void coefficient of reactivity provided by fluid moderator-coolant.

Reactor design and fuel are detailed. Turbine-generator is tandem-compound, 1800 rpm with initial conditions of 600 psig, 650 F. Installed cost is estimated at $207 per net kw electrical and ultimate fuel-cycle costs of 1.92 mills per net kwhr are foreseen. *ASME 59-A-178*

Operating experience and advance designs of sodium-graphite reactors, *R W Dickinson and L E Glasgow, Atomics International*

Two years' operating experience with a 6-mwe sodium-graphite reactor shows feasibility of large power units. During this time over 15-million kwhr has been produced for Southern California.

Operating experience gained has reduced normal startup time after a scram from two hr to 20 min. Liquid-sodium pumps using a frozen-sodium seal have operated over 10,000 hr between shutdowns. The 95% reliability obtained, however, is not adequate for power-plant operation because of the 5- to 10-day delay in gaining access for maintenance.

Experience shows three areas for improvement in sodium-graphite reactors: (1) solution of thermal-stress problems (2) easier accessibility and (3) better neutron economy.

Based on a 255-mwe plant (2400 psia, 1000/1000 F) fuel costs of about seven mills per kwhr are predicted. In larger sizes (540 mwe) fuel costs of about 5.4 mills per kwhr are possible using current prices, estimating methods. *ASME 59-A-192*

Pressure-suppression containment for nuclear-power plants, *C C Welchel, Pacific Gas & Electric Co and C H Robbins, General Electric Co*

A break in the primary-circuit of a water-moderated nuclear-power plant causes the rapid release of contaminated steam and water. Current dry-capsule containment vessels must be large enough to minimize the pressure rize due to this rapid release, producing a large and expensive design.

Tests at Pacific Gas & Electric show the feasibility of venting this contaminated steam-water mixture into a water-pool heat sink. Since the steam is condensed, resulting pressure rise in the containment vessel is very small—only that due to the displacement of air in the dry well surrounding the reactor itself. Containment vessel is therefore very much smaller and less expensive.

Majority of fission products are retained in the water pool, reducing radiation hazard.

Current design work for Humbolt Bay Unit 3 uses results of these tests. *ASME 59-A-215*

Heavy-water-moderated nuclear-power plants, *M S Silberstein, J deFelice and W A Loeb, Nuclear Development Corp and W A Chittenden, Sargent and Lundy*

Heavy-water-moderated reactors for power generation operate on natural-uranium fuel. Although enriched reactors have received most power development attention, natural-uranium plants offer several unique advantages: (1) no dependence on government operation of uranium-diffusion plants (2) no dependence on spent-fuel reprocessing plants (3) no conflict with military requirements in the event of a national emergency and (4) ability to obtain fuel in already-existing free markets.

A 70-mwe prototype for a 200-mwe plant can be built using present technology. Steam-drum outlet will be 1,060,000 lb per hr at 795 psia, 515 F. Reactor recirculation will be 6,480,000 lb per hr. Power costs for the 200-mwe plant are estimated at 11.7 mills per kwhr. *ASME 59-A-185*

continued

Directions for ordering these papers on page 114

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For more facts circle 242 on Reader Service card, p 117

More **technical briefs**

New NEMA standards

Industrial control. This revision covers rating, testing and performance of ac and dc general-purpose controllers and units for specific application. *IC-1-1959 ($6.00)*

Dial arrangement of warm-air-limit and fan controls. Operating range, differential, dial stop and shipping setting for controls are given. *DC 4-1959 ($0.20)*

Shunt capacitors. Includes service conditions, rating, manufacture, testing, application and operating information for shunt capacitors. *CP 1-1959 ($0.50)*

Gas-turbine power plants. Covers definitions, nomenclature, rating, performance and installation of gas-turbine power plants. *SM-30-1959 ($1.00)*

Connectors for copper conductors. Information is given concerning sizes, ratings, secureness, tests and dimensions of compression type connectors. *SG 8.1-1959 ($0.30)*

Molded-case circuit breakers. These standards cover single and multiple air circuit breakers in insulated housings for ratings up to 800 amp and 600-v ac or 250-dc. *AB 1-1959 ($0.40)*

Returnable-reel dimensions for wires and cables. Covers returnable reels used in processing and shipping wire and cable. Establishes reel sizes and holding capacity. *WC 20-1959 ($0.25)*

Summary of characteristics of apparatus insulators. Data on cap, pin and post type insulators is given. *HV 1-1959 ($0.25)*

Large generating and converting apparatus. Covers frequency and phase converters and large hydraulic-turbine-driven generators. *LG-2-1959 ($0.30)*

Nameplate information, ampere rating, voltage rating and load characteristics. Data applies to automatic temperature controls. *DC 6-1959 ($0.20)*

Bituminized-fiber conduits and fittings. Types, sizes, wall thickness, joints and chemical and physical properties for the installation of wire and cable are covered. *BC 1-1959 ($0.30)*

Mechanical-drive steam turbines. Gives characteristics of mechanical drive turbines and includes definitions, nomenclature, shipment and installation instructions and info on steam-piping systems. *SM 20-1958 (Rev Nov 1959) ($2.00)*

Piping systems for steam-turbine-generator units. Outlines principles and requirements for oil, steam-gland and integral steam piping for units from 15,000 to 33,000 kw. *SM 10-1959 ($0.25)*

Connectors for copper conductors. Information is given concerning sizes, ratings, secureness, tests and dimensions of screw type connectors. *SG 8.2-1959 ($0.30)*

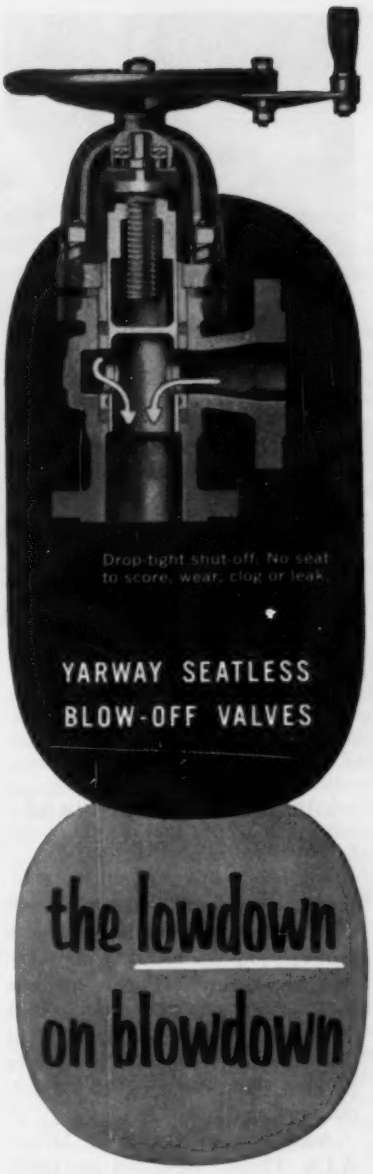
Boiler design

Recent boiler design practice, *W H Rowand and E G Kispert, The Babcock & Wilcox Company*

Increasing electric-power demands combined with higher costs make standby equipment economically impractical. High availability and efficiency, with low maintenance costs are therefore required from all installed equipment. Automatic supervisory controls are gaining in popularity.

Design factors discussed are: (1) firing equipment (including pulverizers and stokers) (2) furnace construction (3) fireside deposition (4) waterside factors (5) once-through boilers (6) superheaters and reheaters (7) economizers and air heaters and (8) typical designs. *ASME 59-A-176*

continued



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Two compact, efficient, automatic CB boilers heat five new buildings for International Minerals and Chemical Corporation

Precision and quality are a must for this company which produces minerals and chemicals for industry and agriculture. It's an attitude that carries over to the equipment they buy. That's why they installed two 100-hp Cleaver-Brooks boilers to heat their dramatic new headquarters at Skokie, Ill.

According to Callix E. Miller, A.I.A. Project Manager for IMC, "Our Cleaver-Brooks automatic packaged boilers are efficient and quiet." He added, "Their styling and performance are in keeping with functional design that characterizes our new headquarters."

W. J. Mullineaux, Plant Engineer, reports, "Cleaver-Brooks four-pass, forced-draft design has proved it can keep our operating costs low. The CB boilers fit in well with the automatic system we have and simplify our entire operation. Hinged doors make routine inspection easy."

Architects and Engineers on the job were Perkins and Will. Builder was Turner Construction Company.

For complete information on Cleaver-Brooks packaged boilers like those installed at IMC, contact your representative or write direct to Cleaver-Brooks Co., Dept. B, 301 E. Keefe Ave., Milwaukee 12, Wisconsin, U. S. A.

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IMC headquarters buildings that are heated by CB boilers include the operations building and annex, administrative building, and employees' lounge-cafeteria.

Technical briefs

Begins on page 100

Industrial-boiler design, *T B Hurst and C C Hamilton, The Babcock & Wilcox Company*

New industrial boilers designed to burn specific fuels have led to changes in common design parameters. Pressure firing, complete furnace water cooling and shop-assembled furnace units are being developed for oil and gas firing. Stoker-fired boilers are designed to encompass a variety of burning principles and grate types.

Furnace configuration in gas- and oil-fired packaged boilers of necessity differs from that of field-erected units. New design parameters for furnace-wall construction are given. For boiler capacities over 100,000 lb per hr, full water cooling of furnace walls is recommended. At lower capacities, partial water cooling is permitted.

Furnace designs for stoker firing must take into account specific coal characteristics. Superheater-design parameters are based on surface fouling conditions and metal temperatures. Boiler-tube-bank designs must recognize effects of cinder and ash erosion. *ASME 59-A-78*

Boiler-feed pumps

Integration of turbine-driven boiler-feed pumps in large power plants, *E L Pace, General Electric Company*

In power plants of 150,000 kw and more, integrated turbine-driven boiler-feed pumps can produce heat-rate improvements of five to 25 Btu per kwhr. Entire unit cycle must be designed from scratch with this drive arrangement, since the extraction turbine normally used serves several bleed heaters. In 2400-psig units, turbine-driven boiler-feed pumps can add 2.5% to net station output by eliminating the large motor drivers.

For 150,000- to 250,000-kw units, full-capacity boiler-feed pumps and noncondensing turbines operate at 6000 to 7000 rpm. In larger units the same pump-turbine arrangement handles half-capacity. Condensing

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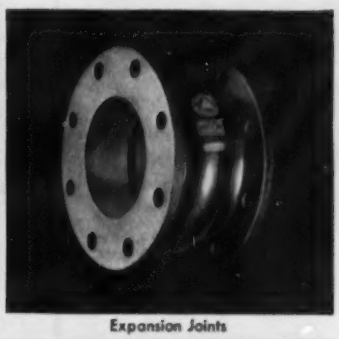
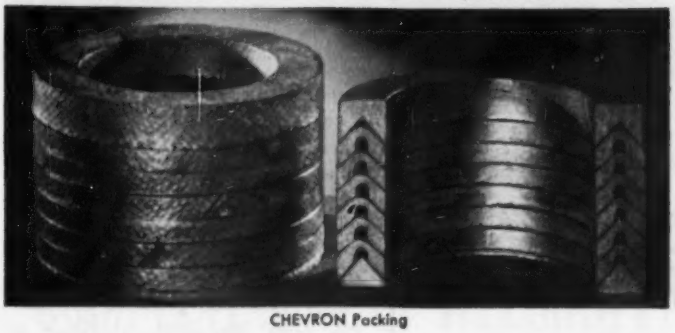


Expansion Joints



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Garlock GUARDIAN* Gaskets provide a safe, positive seal against high temperatures and pressures of steam, oils, gases, liquids. Gasket density, introduced during manufacture, assures dependable sealing under varying service conditions. Used at temperatures to 1050° F, pressures to 2500 psi . . . available in round, oval, square, flat side, diamond, pear and other shapes in practically any size. Large regional warehouse stocks are maintained at Camden, Cleveland, Houston, and San Francisco. Catalog AD-104.

Garlock All-Rubber Expansion Joints prevent noise and vibration in water and condensate lines. They react to the slightest pressure; this relieves any stress on expensive piping. Used against water, oil, mild acids, gases, and exhaust steam. Will withstand temperatures to +180 °F, pressures to 125 psi. Garlock has Rubber Expansion Joints ¾" to 84" in dia.; in round, rectangular, tapered, and offset spool types or U types. Catalog AD-137.

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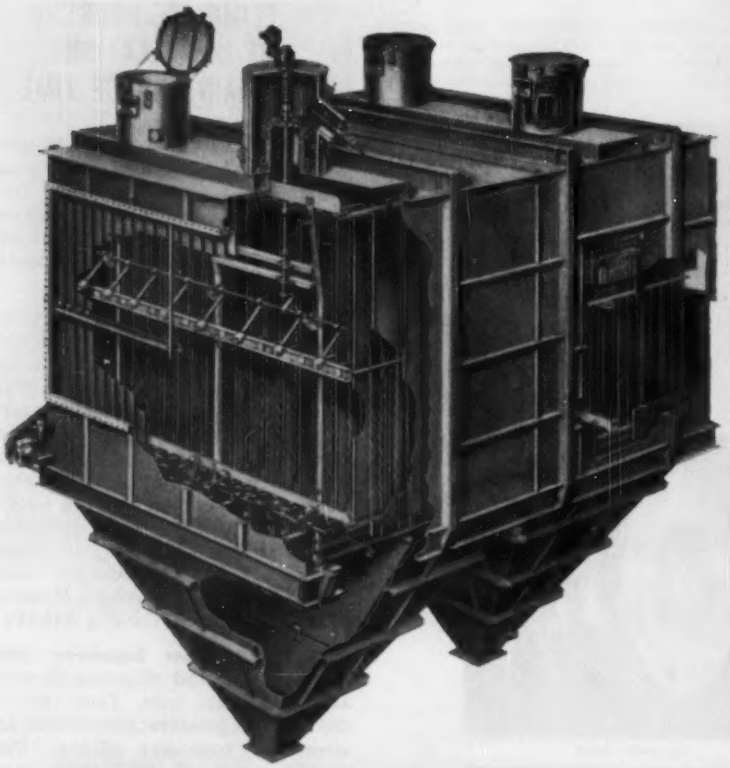

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OF OPERATION PROVES MAINTENANCE OF BUELL 'SF' PRECIPITATORS AVERAGE LESS THAN 2%

In 10 years of selling 'SF' electric precipitators, the number of replacement parts ordered from Buell has amounted to only 1.17% of the total sales! Even on emitting electrodes, usually the most vulnerable part of a precipitator, replacement has amounted to less than 1% of the original number installed. What do these extremely low percentages mean? Exceptionally low maintenance costs, for one thing, continuous high-efficiency operation, fewer shutdowns and process interruptions. Buell self-tensioned emitting Spiralectrodes eliminate vibration found in weight-tensioned wires. Buell's low maintenance precipitators will provide you with the most satisfactory operating results. They're backed by 25 years of experience in dust collection, with the practical know-how gained on hundreds of installations. Write for descriptive literature. The Buell Engineering Co., Inc., Dept. 50-B, 123 William St., N. Y. 38, N. Y. (Subsidiary: Ambuco Ltd, London, England)

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Technical briefs

Begins on page 100

turbines, on the other hand, have a maximum speed of about 5500 rpm due to required last-stage annulus area.

Choice of steam source and disposition for the drive turbine depends upon specific unit evaluation. As many as ten alternates exist, but to date the most popular seems to be cold reheat as initial steam, two bleeds to stage heaters and exhaust to the deaerator or equivalent stage heater in the cycle.

Many features of plant design and operation resulting from turbine drives for the boiler-feed pumps are covered in detail. These include startup, control and emergency conditions. *ASME 59-A-196*

Development of floating-ring type stuffing boxes for Eddystone boiler-feed pumps, *A Brkich and R E Allen, Ingersoll-Rand Company*

Although in many cases stuffing-box pressures and temperatures have gone beyond the capability of solid-ring packing, the high-pressure boiler-feed pumps at Eddystone Station far exceed any suction temperatures and pressures yet encountered—4165 psig at 567.6 F. Over five years' successful experience in floating-ring type stuffing boxes led to their application at Eddystone. But in spite of this experience a full-sized tester was installed in another Philadelphia Electric station to determine operating characteristics at conditions close to the Eddystone design.

Floating-ring stuffing boxes are essentially a bundle of individual seal rings free to move radially in their retainers during momentary load changes. This minimizes radial clearances and greatly reduces leakage. Rings are angularly restrained by lugs and sealing faces are held together by hydraulic pressure when the pump is running. When pump is idle small springs hold the sealing faces together. To prevent flashing in the seal faces, a stepped system of injection and bleeds keeps tempera-

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An announcement of the transfer of welding fittings operations from Milwaukee to Beaver Falls will be made in the near future.

For further details ask for bulletin FDM-2016 or call on any of the local B&W District Sales Offices. The Babcock & Wilcox Company, Tubular Products Division, Beaver Falls, Pa.

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Technical briefs

Begins on page 100

tures well below flash point throughout pressure reduction in the seal. *ASME 59-A-259*

Design of suction piping and deaerator storage capacity to protect feed pumps, *R S Thurston, Cornell University*
Safe boiler-feed-pump operation during sudden load drops has been a subject of considerable study. Several mathematical methods are available to predict operating characteristics of proposed arrangements. But they involve a detailed analysis of heater and boiler-feed-pump system.

A very definite relationship exists between volume of deaerating heater and volume of feed-pump suction piping. A simple formula is evolved using these two volumes and enthalpy differences only. Solution shows the designer changes in either volume — whichever is more convenient—necessary to produce safe boiler - feed - pump operation during severe load drops. *ASME 59-A-20*

Other power services

A miscellany of mitigated corrosion problems of a public utility, *H H deLaneux and H A Medlock, Pacific Gas and Electric Company*
A variety of unusual corrosion problems exists in almost every public-utility system. Solution requires thorough study since actual causes of corrosion may be obscure.

Underground conduits and lead-sheathed cables were subject to corrosive attack. Cathodic protection solved the problem.

A cooling system suffered corrosive attack at the pump and adjacent steel piping. Bronze impellers were installed in the pumps instead of cast iron and the conduit between the main switch and the motor was insulated. Continuity of the galvanic cell was broken and corrosion ceased.

In another cooling system, corrosion occurred near the gate valves. Current measurements were significant only after valves were partially closed, exposing clean bronze parts

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New maximum-safety, self-checking relay prevents losses due to burner safeguard failure and resulting explosions.

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In other flame safeguards, safe-start, self-checking networks operate *only during start up or recycling*. The new R4075 unit operates constantly. It will cause an immediate safety shutdown and sound an alarm if the sensing signal, amplifier or related circuitry fails *at any time* while the burners are operating or during start ups or shutdowns. This same self-checking circuit checks all components of the Protectoglo system including the flame rod once *every* second. You get maximum protection, not only on safeguard systems for constantly burning gas burners using flame rods, but also on gas- or oil-fired systems using Ultra-Vision flame detectors. For information on how the Honeywell R4075 can help your industry, call your nearest Honeywell office; or write: Minneapolis-Honeywell, Dept. PR-2-30, Minneapolis 8, Minnesota.

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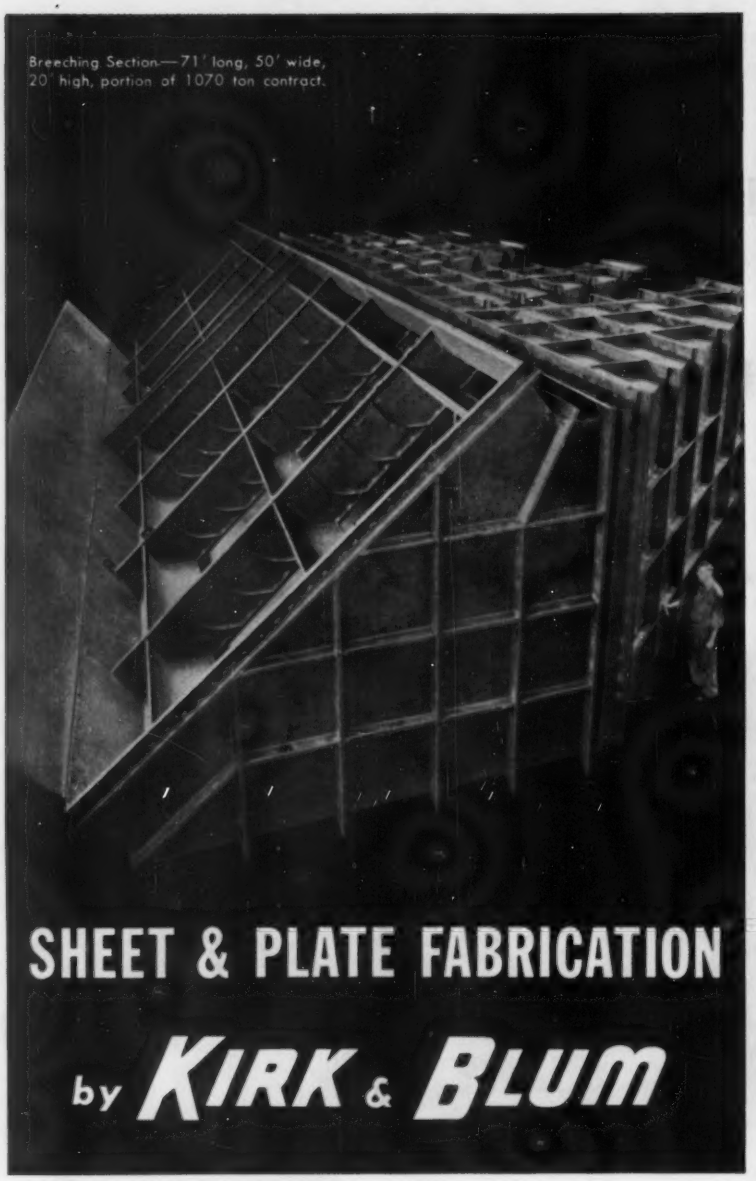

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Technical briefs

Begins on page 100

to the scouring action of the water. Installation of plastic pipe on each side of the valve opened the circuit and reduced corrosion. *Western Regional Division, NACE, Sept 1959*

Lightning protection for electrical equipment—its development and present status, *H R Armstrong, The Detroit Edison Company*

The history of insulation standardization and the development of lightning arrestors is traced back to the years before 1900. Step systems of equipment insulation were once thought to be a logical approach to major-equipment protection. Since it was impossible to accurately determine insulation strengths, however, the step system became impractical. Greater reliance was then placed on lightning arresters.

System grounding made possible the use of lower-rated arresters and less insulation was required.

Basic-impulse insulation levels permit direct comparison between impulse voltage strengths and arrester protective levels. Present overvoltage protective practices are actually a coordination of protective devices. *AIEE 59-499*

The oxidation of lubricating oils at high temperatures, *A L Williams and E A Oberight, Socony Mobil Oil Company*

While oxidation data on lubricating oils is best obtained in actual engines, these tests are too expensive to be practical. Bench tests, long used, are difficult to correlate with field performance. Extrapolation of 300-F test data to 500-F conditions can be very misleading.

This new bench-test arrangement was designed to obtain high temperature oxidation characteristics of lubricating oils directly. A heated disk rotates at high speed in a controlled atmosphere. Hot oil is deposited on the disk and flies off into a collector, and degree of oxidation is measured. Liquid oil and vapors collected separately show no significant difference in oxidation characteristics.

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Why take on the added expense of using heavier valves when O-B valves can do the job for you at lower cost? Ask your O-B distributor about these valves, or write to OHIO BRASS COMPANY, MANSFIELD, OHIO

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Technical briefs

Begins on page 106

In addition to a variety of oils, several antioxidants were tested. Test results are interpreted in detail. *ASME 59-LUB-8*

Pump standardization—a user's concept, *R G Jobe, Shell Chemical Corporation*

In a Shell Chemical plant using some 650 centrifugal pumps, study revealed that 80% of the applications could be covered by one pump designed for 250 gpm at 120-ft total head. This led to a standardization program and development of one new pump for some 500 services.

Pump arrangement features vertical pipe mounting and impeller mounted on motor shaft—no base to grout, no coupling to align. Unit can be built of any castable material and is self-throttled by a plug type discharge orifice. By varying impeller diameters and changing orifice size, plant designers obtain a wide variety of performances and eliminate need for oversized motors.

Unusual arrangement reduces removal and reinstallation costs 75% by permitting shop rather than field maintenance. Actual maintenance costs are reduced by 15 to 25%. *ASME 59-A-162*

Butterfly valves as final control elements, *W J Bestman, Fisher Governor Company*

Butterfly-control-valve applications are on the increase as their advantages become better known. They can no longer be considered as mere dampers.

Factors contributing to their wider use are reduced space requirements, lower first cost, streamlined flow patterns and ease of internal-part replacement (no grinding or precision fitting).

On demineralized-water service butterfly valves operate at 3200 psi, 650 F with a differential of 200 psi;

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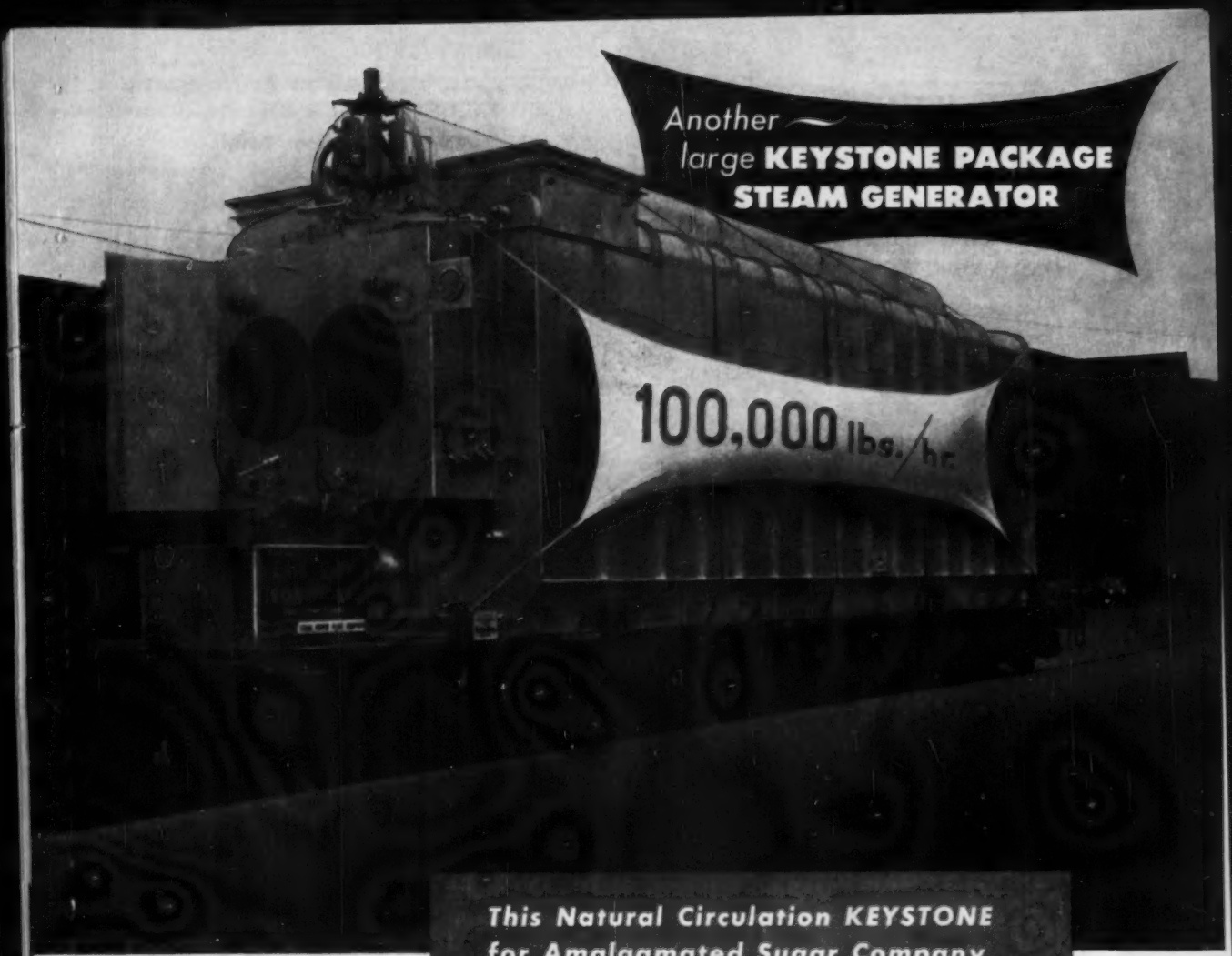

This Natural Circulation KEYSTONE for Amalgamated Sugar Company, Nyssa, Oregon

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The Keystone design was developed in the 1940's for engineers who demand top performance in water tube package steam generators. Unique features of this design make the Keystone the wise choice of engineers who specify and buy package boilers.

- **Symmetrical Design** — Easy to unload — easy to move.
- **Tangent Furnace Tubes** — No troublesome fins or studs required to form furnace or outer walls.
- **Tangent Outside Tubes** — Plus steel jacketed insulation for minimum heat loss.
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Keystones use only tubes for heating surface. No fins, studs or other extended surfaces of questionable value are used. The Keystone packs more real heating surface in the smallest space resulting in lower exit temperatures and highest efficiencies. *Get the details in Bulletin SB-5901-B.*

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935-psig steam at 650 F is controlled with a differential of 5 psi.

Piston-ring butterfly valves are specifically designed for low leakage values down to 450 scfh in a 16-in. size handling 1000-F gas.

Resilient seat valves designed for tight shutoff operate on a differential of 350 psi and at temperatures up to 450 F.

A wide selection of materials is available to meet many severe services. Rubber linings can be furnished to handle corrosive liquids and gases. *ISA 18-59*

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American Society of Mechanical Engineers. Contact ASME, 29 W 39th St, New York 18, N. Y. Members 40c; nonmembers 80c.

American Institute of Electrical Engineers. Contact AIEE, 33 W 39th St, New York 18, N. Y. Members 40c; nonmembers 80c.

National Electrical Manufacturers Association. Contact NEMA, 155 E 44th St, New York 17, N. Y. Prices as indicated.

Instrument Society of America. Contact ISA, 313 Sixth Avenue, Pittsburgh 22, Pa. Members 35c; nonmembers 50c.

National Association of Corrosion Engineers. Reprints will be available after publication in Corrosion; contact NACE, 1061 M & M Building, Houston 2, Texas. Prices not established.

Total generating capability of U.S. electric industry reached 159 million kw in '59, an increase of 10.3% over 1958, according to Edison Electric Institute.

Second industrial 5-year Plan of United Arab Republic will cost $1.28 billion including $280 million for power and public-utility projects.

Here's POWER to clean tubes from 1/2" to 2" QUICKLY

Rotojet Junior Tube Cleaners are unusually powerful for their size and weight. They are fed easily through the tubes with the operating hose, and can be shifted quickly from tube to tube. Their convenient size, speed, and ease of operation offer a marked contrast with external cleaners costing many times more.

An air valve directly behind the Rotojet motor permits one-man operation. Very little headroom is required, and either vertical or horizontal tubes can be cleaned.

Simplicity of Rotojet design and precision construction assure long service, efficient use of power, and freedom from trouble. Economical brushes, cutters, and scrapers meet practically any requirement.

Send for Bulletin J-410.

Expanding scraper and replaceable element.

Expanding brush and replaceable element.

Sectional wire brush.

Air valve for one-man operation.

ROTOJET® Junior TUBE CLEANERS

ELLIOTT COMPANY – ROTO PLANT

Tube Cleaner Specialists Since 1910

153 Sussex Avenue, Newark, N. J.

For more facts circle 255 on Reader Service card, p 117

circle 256 on Reader Service card, p 117

U. P. GENERATING COMPANY FOUND A WAY TO BE SURE
OF CHOOSING THE RIGHT TURBINE OIL

They selected NONPAREIL —the only oil with life-of-turbine guarantee

Situation: In 1955, Upper Peninsula Generating Company installed a 22,000 kw General Electric turbine in its Presque Isle station. When lubricant for this turbine was chosen, U. P. management elected to install an oil with a life-of-turbine guarantee—NONPAREIL.

But that wasn't all plant management received when the decision was made to buy NONPAREIL Turbine Oil. In addition, Duane Johnson, Standard Oil lubrication specialist located in Marquette, made a complete lubrication survey of the entire plant. He provided technical service on lubrication during construction and after operations started.

What has happened: In the four years since installation, the turbine has performed satisfactorily without any lubrication difficulty. In a routine inspection a year after installation, the bearings proved to be in excellent condition. Periodically samples of the oil have been removed for analysis at Standard Oil's Whiting laboratory. The oil remains in its original excellent condition.

What you can do: Get this life-of-turbine guarantee on the turbine oil you install by specifying NONPAREIL. Call the lubrication specialist in the Standard Oil office near you anywhere in the 15 Midwest or Rocky Mountain states. Or contact **Standard Oil Company (Indiana), 910 South Michigan Avenue, Chicago 80, Illinois.**

You expect more from STANDARD *and you get it!*

Standard Oil lubrication specialist Duane Johnson (left) and station chief engineer Charles York, inspect 22,000 kw G-E turbine at Presque Isle station. On lubrication jobs of this kind Duane Johnson is well qualified to provide technical service. He has an engineering degree from the Michigan College of Mining and Technology plus 10 years' experience with Standard in this work. He has also completed Standard's Sales Engineering School.

Quick facts about
NONPAREIL
TURBINE OIL

- Will not permit formation of harmful acids
- Will not permit formation of sludge or oil varnish
- Will maintain good demulsibility or water-separating characteristics
- Has high resistance to foaming
- Contains adequate rust inhibitor

So many ways the ***FISHER/MAN***
can give you a helping hand with the

WIZARD II
PRESSURE CONTROLLERS

- Two Position Controller
- Proportional Controller
- Proportional Controller —Remote Set
- Differential Proportional Controller
- Pressure Transmitter
- Differential Proportional Controller— Remote Set
- Proportional Reset Controller
- Differential Proportional Reset

This "Jack of ALL Trades" is surprisingly low in cost

The partial list of applications at left tells you why the Wizard II is so aptly named. Probably no other controller in the Fisher line is as versatile. Available in brass, steel or stainless steel Bourdon tubes for ranges from 25 to 10,000 psi. Brass or stainless steel bellows available for low pressure service from 30" Hg Vacuum to 30 psi.

Fisher has carefully designed each component of the new Wizard to satisfy the most rigid process control requirements. A completely descriptive and illustrated booklet on the Wizard II is yours for the asking. Write for Bulletin D 4150 A.

IF IT FLOWS THROUGH PIPE ANYWHERE IN THE WORLD . . . CHANCES ARE IT'S CONTROLLED BY . . .

FISHER GOVERNOR COMPANY

Marshalltown, Iowa / Woodstock, Ontario / London, England

CONTINENTAL EQUIPMENT CO. DIVISION, Coraopolis, Pennsylvania

FISHER Governor

SINCE 1880

For more facts circle 257 on Reader Service card, p 117

Your service center for FREE data

Either of the no-postage Reader Service cards below and p 117B will bring you information on any new equipment listed or product advertised, plus new literature for your files

- **Study New Equipment** described in this issue starting on p 130. Circle numbers on card corresponding to items listed
- **Check New Literature** available this month beginning on p 117A. To get your personal copies use the card below
- **Read advertisements** and note number listed under each ad. Circle ad numbers on card for complete details
- **Print your name and company on front of card**

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New free literature

AIR CONDITIONING, HEATING, REFRIGERATION AND VENTILATION

101 **Air-cooling** units are topic of 12-p bulletin 500. Sectional construction of units permits fan and pan sections to fit varied coil styles. Includes tables of dimensions. Frick Company

102 **Air conditioning** and refrigeration are featured in 34-p bulletin 30-F describing firm's complete line. Related components, operating principles are covered. Frick Company

103 **Thermal insulation** for metal buildings and industrial equipment is discussed in 4-p bulletin I-10. Columbia Acoustics and Fireproofing Company

104 **Refrigeration** and air-conditioning valves, heat exchangers, components are topic of 20-p catalog R-7. Superior Valve & Fittings Company

105 **Thermostatic expansion valves,** regulators, controls for refrigeration systems are topic of 12-p catalog 59A. Sporlan Valve Co

106 **Filter cloths** for dust and fume collectors are featured in comparison chart. Selection guide contains info on cotton, nylon, orlon, dacron and silicone-treated glass. Wheelabrator Corp

107 **Cloth dust collector** with continuous, reverse air cleaning of cloth is subject of 4-p brochure. Dustex Corp

108 **Induced - draft fans,** industrial fans are rated with specifications, outline dimensions in bulletins L-3, L-5. Installation and ordering info is included. Fuller Company, Lehigh Fan & Blower Div

109 **Air-mixing units** with automatic volume-control features are covered in 14-p bulletin DD-6. Dimensions, performance data are given. Buensod-Stacey, Inc

110 **Electronic air cleaner** is topic of 12-p bulletin 405. Diagrams, photos and specs are given. Dollinger Corp

METALS AND MATERIALS

111 **Static, centrifugal** and shell-molded castings are covered in 2-p brochure G-159. Includes physical-properties table, standard designation and stress-temperature curves for selected high alloys. The Duraloy Company

112 **Packaged low-temperature alloys** are described in folder 10259. Alloy characteristics, application method and uses are covered. All-State Welding Alloys Co, Inc

113 **Vacuum-induction-melted alloys** are topics of two 8-p bulletins. Corrosive and heavy-duty h-t applications are discussed. Kelsey-Hayes Co, Metals Div

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114 **Cast-bronze alloys** are featured in 4-p brochure. Chemical and physical specs of 29 types are given. Renewal Service Inc

115 **Specialized alloys** for glass-to-metal hermetic sealing are subject of 4-p brochure. Wilbur B Driver Company

116 **Heat-resistant glass,** flat borosilicate type, is topic of catalog and price list. Glass comes in square, rectangular, circular and odd shapes. Kaufman Glass Co

117 **Cryogenic fluids** are discussed in pocket card. Physical-property equivalents are given. Union Carbide Corp, Linde Co Div

COMPRESSORS AND ACCESSORIES

118 **Packaged-pickup compressor** rated 300 hp and packaged compressors with hp ratings of 100 to 500 are featured in bulletins 91 and 92. Operating characteristics and construction details are included. The Cooper-Bessemer Corp

119 **Refrigerated filter,** condenser type, dehydrates and filters compressed air—4-p bulletin F-100 includes colored flow chart. Hankison Corp

120 **Rotary stationary compressors** are specified in catalog of firm's line. Form E-269 has 8 pp. Davey Compressor Company

121 **Complete line** of firm's compressed-air products is presented in color-coded 24-p catalog 158—compiled for quick reference. Wilkerson Corporation

MATERIALS HANDLING

122 **Sectional-belt conveyor** is topic of bulletin 458. Technical data is included. Stephens-Adamson Mfg Company

123 **Multipurpose dumpers,** containers and conveyors are discussed in 8-p catalog 59 with load capacities and dumping heights given. Essex Conveyors, Inc

124 **Direct, indirect coolers** and dryers, electrical and mechanical vibrating types, are featured in 32-p catalog 963. Discussion includes info on auxiliary equipment in vibrating line. The Jeffrey Mfg Co

ELECTRICAL GENERATION, TRANSFORMATION AND CONVERSION

125 **Electric plants** in sizes from ½ to 100 kw are subject of 12-p folder illustrating firm's line. Kohler Company

126 **Silicon zener diodes,** 6- and 12-amp silicon-diffused junction rectifiers are topics of brochures SR-260, SR-311. Over 150 standard types of hermetically sealed

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NEW FREE LITERATURE continued.....circle key numbers, page 117, for your copies

diodes are listed. International Rectifier Corp

127 **Constant - voltage** silicon - rectifier chargers for stationary batteries are discussed in data sheets. Includes curves and statistics on performance. The Electric Storage Battery Company, Exide Industrial Div

128 **Flexible-silicon power rectifiers** for any voltage and current are covered in 8-p brochure 6101-1A. Info should aid engineers, consultants and scientists. I-T-E Circuit Breaker Company

ELECTRICAL DISTRIBUTION AND PROTECTION

129 **Single-phase ac regulators** for 3-phase circuits are discussed in application bulletin AC610. Sorensen & Company

130 **Circuit breaker** with rating from 5 through 75 amp is topic of 2-p brochure GEA-6759. General Electric Company

131 **Molded-case circuit breakers** are described in 40-p bulletin 5001-1A. Breakers range to 100,000 amp interrupting capacities. Reference chart pictures each type and gives info on ratings, overcurrent devices, accessories and modifications. Specs and test requirements are included. I-T-E Circuit Breaker Company

132 **Stored - energy** power circuit breakers, low-voltage type, are described with photos, diagrams, graphs and charts in 20-p bulletin GEA-5915 E. General Electric Company

133 **High-frequency bus duct** is topic of 12-p booklet B-7326-330. Westinghouse Electric Corp

134 **Sensitive relays** are discussed according to input power, contact rating, coil resistance, enclosure dimensions and terminal styles in 4-p brochure. General Automatic Corp

135 **General-purpose relays** are covered in data sheet. Artisan Electronics Corp

136 **Application of solenoid** locking mechanism to standard rotary switches is described in data sheet. Electro Switch Corp

137 **Silicone rubber** used as cable insulation is topic of bulletin CDS-208. Properties of electrical-grade silicone rubber and application areas are listed. General Electric Company

138 **Enclosed-fuse cutouts** are featured in 12-p bulletin GEA-6208B. Info on operation and features is given. Rating is 5.2 and 7.8 kv, 50 and 100 amp. A 28-p bulletin, GEA-6825, gives info on firm's complete line of oil-filled cutouts rated 5.2 kv, 100, 200, 300 amp and 7.8 kv, 100 amp. General Electric Company

139 **Sectional and 1 - piece terminal** blocks, solderless connectors for wire splicing and terminating, squeeze type connectors for nonmetallic sheathed cable, insulated conduit bushings and knock-out plugs are covered in catalogs 76, 85. Buchanan Electrical Products Corp

continued

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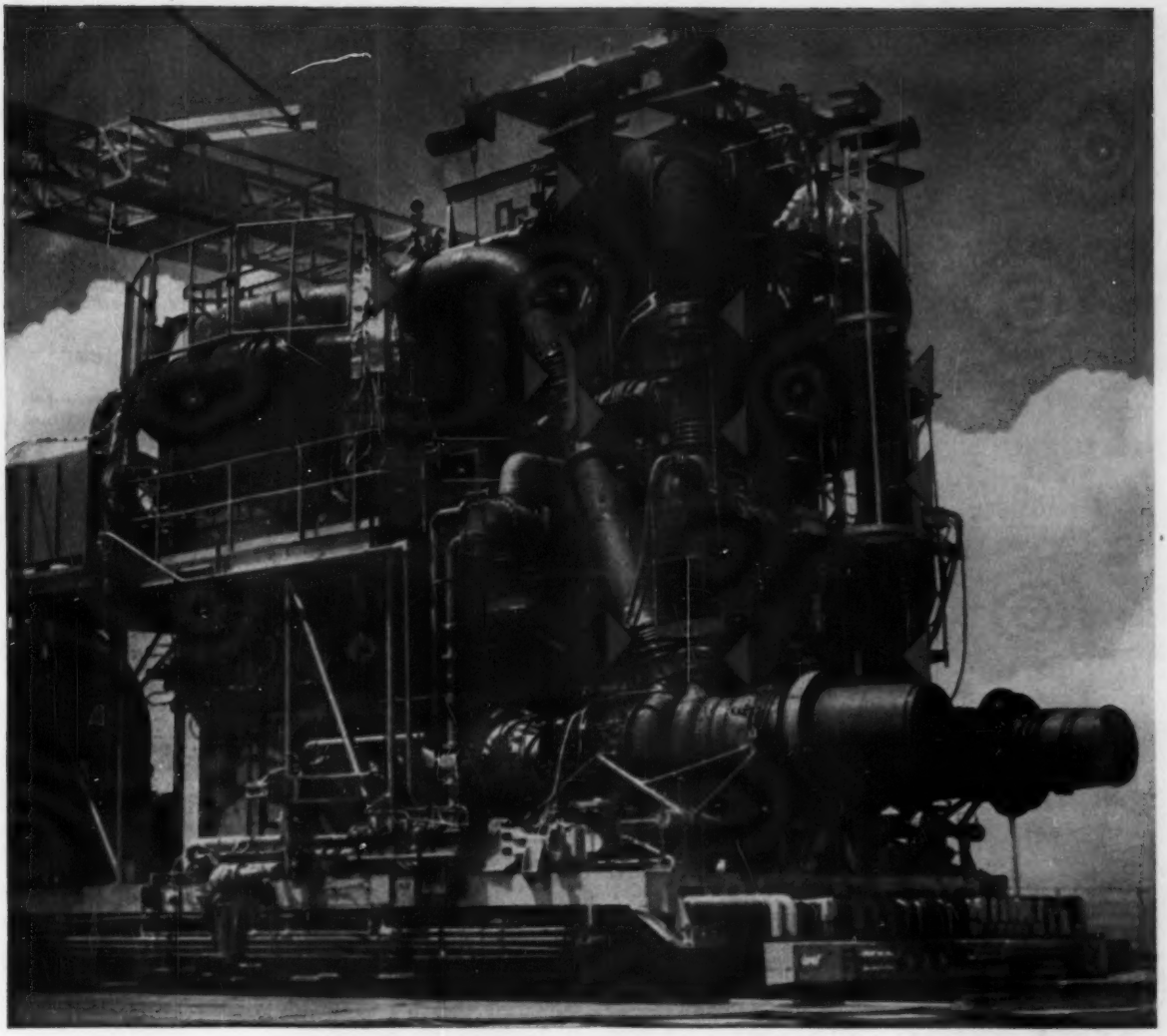

Where expansion joint reliability really counts... YOU FIND ZALLEA

Eighteen Zallea Expansion Joints protect all the piping between compressor, reactor and turbine in General Electric's Heat Transfer Reactor Experiment (HTRE). Sizes range from 18-in. to 30-in. diam. Temperatures are 500 F and 1500 F at 53 psig.

Objectives of HTRE were to develop and test a complete aircraft nuclear power plant system, to determine operating characteristics, and to verify the design of a direct-air-cycle nuclear propulsion system. As in any research involving unknown quantities (in this case the heat source) a basic requirement for all system components was *maximum reliability*. The results of HTRE were successful. Objectives were accomplished. The integrity and life of all system components were verified.

This is another example of Zallea competence in the nuclear field. In fact, Zallea has provided the large majority of all the expansion joints used in atomic, nuclear and missile projects. Our work with almost every major engineering and manufacturing firm in these fields has given us an unequalled background of experience and engineering capacity. It can give you important savings in time and investigation when expansion is involved in piping systems or tanks.

Write for Catalog 56, which contains complete and comprehensive engineering data for Expansion Joints from 3-in. to 50-ft. diam., pressures to 3600 psi, temperatures to 1600 F.

ZALLEA BROTHERS, Taylor and Locust Streets, Wilmington 99, Delaware.

Zallea FOR MAXIMUM RELIABILITY

WORLD'S LARGEST MANUFACTURERS OF EXPANSION JOINTS

For more facts circle 258 on Reader Service card, p 117

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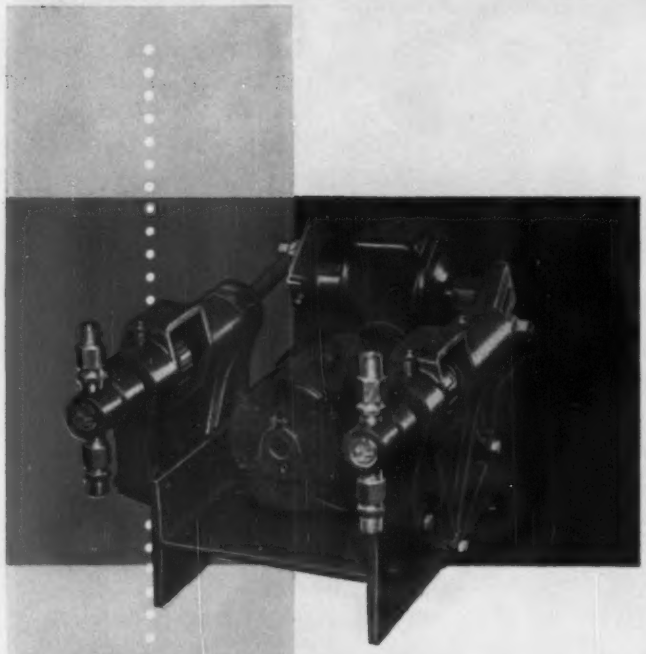

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B-I-F *Proportioneers* **Adjust-O-Feeder**

Gives Application Versatility
At Low Initial Cost

Meet changing requirements without changing your entire pump! Low cost change-over, with plug-in reagent ends, makes Model 1140 Proportioneer® extremely versatile in the capacities and types of chemicals it can handle. Compare these performance characteristics with competitively priced pumps:

Accuracy within ±1% of set rate.
Adjustment range of 15:1 (not 10:1 as most).
Capacity from 0.8 gph to 850 gph.
Discharge pressures up to 1340 psig.

You'll find opportunities for cutting costs and improving efficiency in process feeding when you consult B-I-F — manufacturer of the most complete line of solid and liquid feeders.

B-I-F *Industries*

BUILDERS-PROVIDENCE • PROPORTIONEERS • OMEGA
METERS • FEEDERS • CONTROLS / CONTINUOUS PROCESS ENGINEERING

For complete details on Model 1140 request Bulletin 1140.20-1. Write **B-I-F Industries, Inc., 354 Harris Ave., Providence 1, R. I.**

Free literature

Begins on page 117A

140 **Yoke-actuator switches** are topic of spec sheet 166. Price info included. Minneapolis-Honeywell Regulator Co, Micro Switch Div

ELECTRICAL APPLICATION

141 **Area floodlighting** is discussed in 16-p booklet 2719. Crouse-Hinds Company

142 **Emergency-lighting equipment** is topic of 8-p catalog LW-1. Electric Cord Company

143 **Electric-power drives** with ratings from ¼- to 200 hp, 0.2- to 4660 rpm in variations from 2:1 up to 10:1 are covered in 68-p expanded catalog 258. Prices, dimensions, modifications are included. Simplified numbering system aids selection. Sterling Electric Motors

144 **Switches and terminals** are covered in 24-p catalog which gives detailed info on firm's expanded product line. Terminal section provides tabulated data of male and female terminals giving dimensions, wire sizes and method of attaching to wires. Ark-Les Switch Corp

145 **Precision switches,** 2-circuit models for use on machine-tool limit and control mechanisms are topic of spec sheet. Minneapolis-Honeywell Regulator Company

HEAT EXCHANGE AND CONDENSERS

146 **Heat-exchanger** and condenser tube price list 3-71 has 4 pp. Scovill Manufacturing Company

147 **Heat-transfer data book** has 48 pp, features sections on pipe coil, fin coil, reference and design. Booklet includes formulas and charts, useful tables. Some features are altitude correction, conversion-factor and temperature tables, psychrometric chart. Rempe Company

148 **Heat-transfer equipment** is covered in 32-p catalog HE-3. Gives photos of firm's line. Henry Vogt Machine Company

149 **Surface condensers** are subject of 16-p booklet. Design, construction of units are described and illustrated with shop and installation photos. Sectional drawings, tables given. Elliott Co

INSTRUMENTATION

150 **Liquid meters** are topic of 20-p bulletin 43. Size, capacity, price

the **WALWORTH CUSTOMER** *gets*

VALVE SOUNDNESS THROUGH RADIOGRAPHY

. . . here's how he gets it

When the Walworth Customer needs valves for high-pressure, high-temperature steam service or boiler feed service, he wants to know about quality control: is every single valve thoroughly examined and tested to insure long, safe operating service? When he studies Walworth Pressure-Seal Steel Valves, he learns that *every* pressure containing casting of *every* Walworth Pressure-Seal Valve is completely radiographed.

Further, he learns that Walworth foundrymen, machinists and technicians work together as a team to make sure Walworth Pressure-Seal Valves will deliver lasting dependability.

If you, like the Walworth Customer, invariably insist on convincing proof of quality, we want you for a customer, too. For full details on the full line of Walworth Pressure-Seal Steel Valves, see your nearby Walworth distributor.

Or write **WALWORTH** *750 Third Avenue, New York 17, N. Y.*

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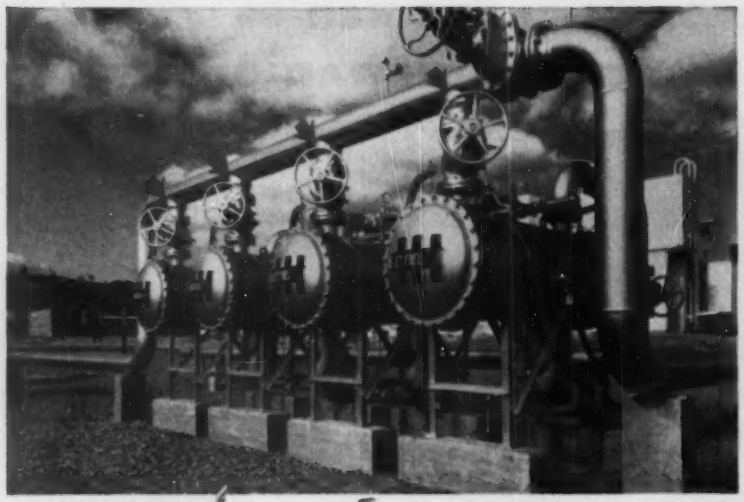
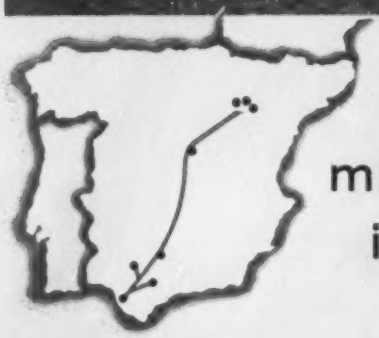
For more facts circle 260 on Reader Service card, p 117



Markowitz Bros. Inc., Mechanical Contractors
Miami, Florida



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WELDOLETS were used for all branch connections on pumping station piping

Reinforced branch connections constructed with Weldolet Welding Fittings provide assurance of quality workmanship at the critical branch connection.

Savings in purchase price and construction on this project alone were high in the six figures. Piping designers and contractors who are interested in similar savings on their jobs are invited to write us for the Bonney Spanish Pipeline Brochure.

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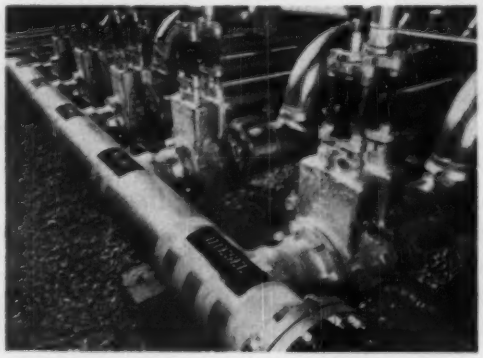

BONNEY FORGE and TOOL WORKS
ALLENTOWN, PENNSYLVANIA

Free literature

Begins on page 117A

tables aid selection. Buffalo Meter Company

151 **Subminiature indicator,** showing elapsed-time operation, is described in product specification sheet 5001. Waltham Precision Instrument Company

152 **High-voltage ac test sets,** console type, are topic of 4-p bulletin GEA-6839. Ratings are 20,000 to 50,000 v, 2-kva capacity for dielectric testing of insulation, components and apparatus up to 50 kv. General Electric Company

153 **High-voltage ac test sets** with ratings from 50,000- to 350,000-v test voltage, 5 to 1000 kva for dielectric testing of insulating materials, motors and generators, transformers are topic of 4-p brochure GEA-6843. General Electric Company

154 **Thermometers** for outside use on pipelines or tanks are featured in 4-p bulletin F2. Precision Thermometer & Instrument Co

155 **Discharge counter** for recording-station and intermediate-class lightning-arrester operations is subject of 4-p bulletin GEA-6985. General Electric Company

156 **Electronic solution controller** is described in 4-p booklet. Electro Mechanisms Corp

157 **Portable indicating pyrometer** for temperatures between −40 and 200 F is featured in 4-p brochure 2146-C. Illinois Testing Laboratories, Inc

158 **Precision frequency meters** with ranges between 10 and 1700 cps are described in bulletin 32. James G Biddle Company

159 **Packed, spring-loaded** thermocouple for high-pressure high-velocity steam-temperature measurements is topic of spec sheet S001-1a. Minneapolis-Honeywell Regulator Company

160 **Thermocouple probes** to measure furnace and flue-gas temperatures to 3100 F are discussed in spec sheets 8, 8.3. Aero Research Instrument Company, Inc

161 **Multijunction thermocouple** terminal boxes are covered in 4-p bulletin 28. Thermo Electric Co

162 **Pneumatic controller** for pressures to 170 psig is described in 2-p product spec sheet P41-2. Bailey Meter Company

continued

COPPUS BLUE RIBBON PRODUCTS

Coppus Vertical Steam Turbine

THE MARK OF QUALITY — There's no better test of a turbine's quality than performance. And the new, ruggedly designed, power-packed Coppus Turbines pass all performance tests with top honors! Small wonder. Coppus quality is literally designed and built into them. Their super stamina is the end-product of painstaking craftsmanship, finest materials and methods, thorough testing and control. Each truly deserves its Blue Ribbon . . . assurance of *complete* reliability.

Typical Coppus Blue Ribbon features are: *totally enclosed governor . . . totally enclosed and independently operated safety trip . . . easily replaceable packing and bearings . . . multiple steam nozzle control . . . brake rim for added safety . . . wide bucket "L" type wheel (optional) for minimum water rate.* You get higher efficiency operation . . . less down time . . . lower maintenance costs.

Coppus Turbines are built to customers' specifications, including API and NEMA standards. Send for Catalog 200. Get complete details on Coppus Turbines. Sizes from 1 HP to 250 HP. Write COPPUS ENGINEERING CORPORATION, 182 Park Avenue, Worcester, Mass. Sales Offices in *Thomas' Register*.

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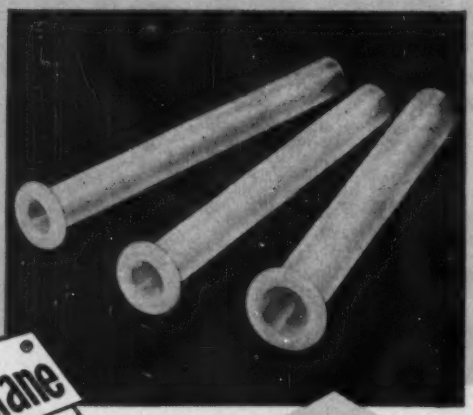
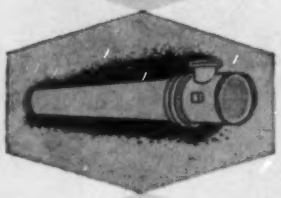
STEAM TURBINES

Lengthen Condenser and Heat Exchanger Life



John Crane

Plastic* Tube Protectors

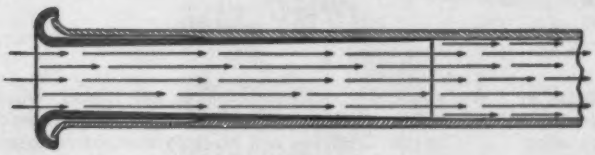


- Protect tube ends for life of tube.
- Positively prevent erosion and abrasion.
- Reduce costly tube maintenance and replacement.
- Easy to install—just slip into tube inlet after coating outer surface with cement.

* Nylon, Polyethylene or Phenolic Resin

PLUS EXCLUSIVE FREE-FLOW DESIGN

Wall thickness gradually tapers toward discharge end. Assures smoothest possible water flow, eliminates turbulence.



Get the facts. Request new Bulletin P-335.

John Crane CRANE PACKING COMPANY

6430 Oakton Street, Morton Grove, Illinois (*Chicago Suburb*)
In Canada: Crane Packing Co., Ltd., Hamilton, Ont.

Free literature

Begins on page 117A

163 **Electronic probe** to detect, locate and measure noise and vibration in machines and mechanical systems is detailed in data sheet. Erwood Inc

164 **Multipointer gage units** for pressure and level measurements and pneumatic transmitting, receiving are described in 4-p brochure M42-2. Bailey Meter Company

165 **Guide to industrial temperature measurement and control** is 23-p booklet compiled to eliminate guesswork in temperature indication. The Partlow Corporation

166 **Relay analyzer** is topic of data sheet. Schmeling Electronics

167 **Motor-control catalog** 5900 is 72-p condensed listing of firm's products. Selector charts give hp, motor speed, heater size, heater amp ratings, enclosure choices with style numbers and prices. Furnas Electric Company

168 **Explosionproof controls,** indicating, nonindicating and recording types, are discussed in 4-p booklet. The Partlow Corporation

169 **Special-purpose** and general analog computers and accessories are described in 4-p brochure. Computer Systems, Inc

170 **Condensate-flow regulator** is detailed in data sheet. Stickle Steam Specialties Company

171 **Instrumentation** for industrial wastes is discussed in 36-p compilation of reprints. Features case histories of how instruments are applied to waste-treatment systems to prevent stream pollution. Minneapolis-Honeywell Regulator Company

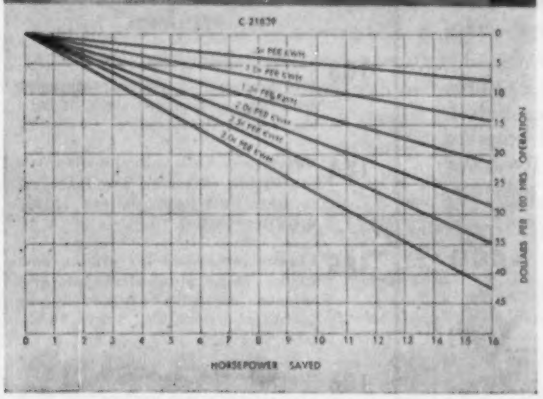
172 **High-capacity flowmeter** with integral bypass design is detailed in spec sheet DS-132. Brooks Rotameter Company

173 **Radiation detection** and measuring instruments for research, industrial applications are discussed in 36-p catalog I-60. Uuclear Measurements Corp

174 **Nuclear instruments,** technical services of organization are topic of 36-p catalog 59. Domestic price list is included. Nucleonics Corporation of America

175 **Pneumatic-transmitting rotameters** are featured in bulletin 18N. Photos sectional drawings aid selection. Schutte and Koerting Company

continued



How do you know when you need a new pump?

"One way is to calculate power saving," writes Phil Olmstead, *Chief Engineer*, Goulds Pumps, Inc.

If your *needs* have changed since you installed your present pump, or . . .

If *efficiency points* have changed due to deposits building up in your piping, or . . .

If your present pump is *frequently under repair*, then . . . it's about time you began thinking about getting a new pump!

That's a pretty good rule of thumb to go by when the time comes to consider replacing an old pump with a new, efficient unit. But you don't have to rely merely on rules of thumb—you can actually *calculate* the power saving a new pump will bring you. Let me illustrate:

Only recently I discussed and demonstrated power saving with an engineer friend of mine. He had a pump that he had purchased five years ago. At that time its efficiency was high . . . but changing conditions led to reduced efficiency. According to the pump curve, its efficiency had dropped to 73 per cent: *600 gallons per minute @ 240 total dynamic head* (*pressure*).

To prove a point, we went through the Goulds catalog and found a pump with the same rating but which was 82% efficient.

Next we merely applied the following formula to determine the brake horsepower:

$$BHP = \frac{\text{Gallons per Min.} \times \text{Total Head in feet}}{3960^{*} \times \text{Pump efficiency expressed as a decimal}}$$

*Horsepower conversion figure (foot-pounds to gallons per minute)

This is what we got:

$$\text{OLD PUMP: } \frac{600 \times 240}{3960 \times .73} = 49.8$$

$$\text{NEW PUMP: } \frac{600 \times 240}{3960 \times .82} = 44.3$$

HP SAVED: 5.5

Now check the savings chart illustrated on this page. Follow the "HP saved" line to the electric current rate line—in this case, 2¢ per KWH. The savings per 100 hours of operation would be approximately $10. At, say, 10 hours a day, 300 days per year, my friend saw that he would be saving around $300 with a new pump.

Try it for *your* pump. Calculate how much you would save with a new Goulds pump replacing your old one. Then call in a Goulds application engineer to talk it over and determine the *right* one for your needs. Or drop a line to me, Phil Olmstead, at Goulds Pumps, Inc., c/o Dept. PO-20, Seneca Falls, New York, and I'll see that you get the information you need.

GOULDS PUMPS

For more facts circle 264 on Reader Service card, p 117

R-P&C Electric Furnace Iron

Better quality control of Iron Valve castings —through electric furnace melting

Castings manufactured from iron melted in electric furnaces have long been recognized for their superior qualities. The electric melting process permits a closer control of heat and chemical composition.

R-P&C's foundry produces electric furnace iron castings that meet the exacting requirements of good pressure castings. They provide a highly refined metal relatively free of impurities. Its dense grain structure gives it increased resistance to corrosion, high tensile and transverse strength, and excellent deflection characteristics. Physical requirements far exceed the standard requirements for valve castings.

Shown above is an R-P&C **Fig. 625 Gate Valve** of the flanged end type. It is available in sizes from 2" to 24". It can be supplied in bronze trim or all-iron construction. The R-P&C Iron Valve line includes other popular types of Gate, Globe, Angle and Swing Check Valves—manufactured of Electric Furnace Iron.

Your R-P&C distributor can supply you promptly with gate, globe, angle and check valves in bronze, electric furnace iron and cast steel, and forged steel; all in a wide range of sizes, styles and pressure classes. He also offers specialties such as Lubrotite gate valves, bar stock valves, asbestos packed cocks, cast steel fittings and pressure-seal cast steel valves. *See him or write...*

R-P&C VALVES

ACCO

R-P&C Valve Division, American Chain & Cable Company, Inc.

Reading, Pa., Atlanta, Boston, Chicago, Denver, Detroit, Houston, New York, Philadelphia, Pittsburgh, San Francisco, Bridgeport, Conn.

Free literature

Begins on page 117A

176 **Anticoincidence preamplifier** for low-level beta counting is subject of 4-p bulletin. Smith-Florence Inc

177 **Control panels** designed for process - equipment control, remote control of systems handling and processing dry solids are featured in 12-p bulletin G-9. Fuller Co

WELDING

178 **Guide to preheat** is 40-p booklet describing successful welding of problem steels, low-alloy high-tensile and other alloy steels. Physical and chemical changes taking place during and after welding are outlined. J B Nottingham & Co, Inc

179 **Electrode pocket guide** is 64-p booklet covering info on all types of electrodes available from firm. Booklet contains tables of recommended electrodes for welding popular-trade-name and ASTM steels and comparisons of electrodes. Air Reduction Company, Inc

LUBRICATION

180 **Portable oil-testing kit** is subject of new bulletins. Kit is for maintenance of gasoline, diesel and gas engines. Lengor, Inc

181 **Conveyor lubricators** are topic of 8-p catalog CL459. J N Fauver Company, Inc

182 **Lube labels,** all-vinyl self-sticking type for standardized identification of lubrication points are featured in data sheet 510B. W H Brady Company

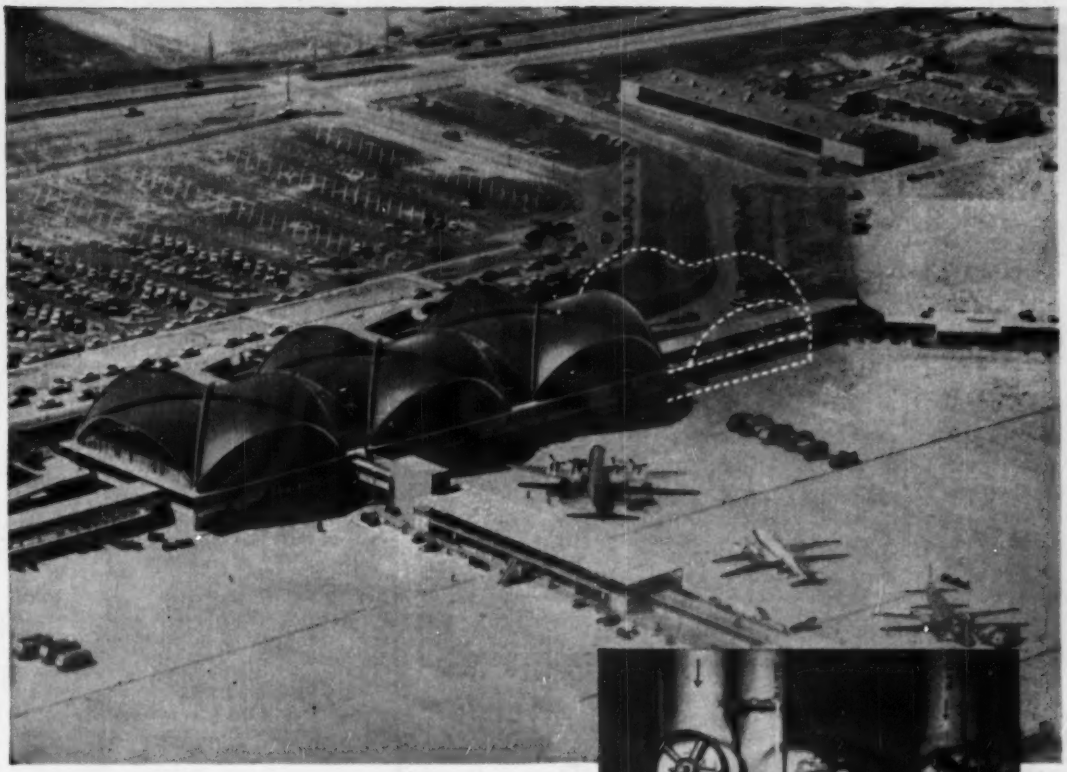
MAINTENANCE

183 **Safety-cleaning solvents** for electric motors, components, generators, controllers are topic of info sheet. Harco Chemical Company

184 **Rotor-jet,** hydraulic-jet-cleaners for inside of tanks are featured in new bulletins. Sellers Injector Corporation

185 **Liquid compound** for steam, emulsion, immersion, ultrasonic and wipe-on cleaning is introduced in technical literature. Turco Products, Inc

186 **Products and methods** for chemical cleaning are detailed in 18-p



Nalco protects vital services of new

LAMBERT-ST. LOUIS AIRPORT

Functional efficiency is usually one of the hallmarks of fine architecture and it is apparent throughout the new St. Louis Municipal Airport Terminal Buildings.

Vital service facilities are housed in a low, clean-lined power plant, well separated from the present main terminal building in anticipation of planned expansion to accommodate increasing airline traffic. The Nalco System protects boiler and cooling water systems by effectively controlling scale, corrosion and microbiological growth . . . a non-architectural supplement to functional efficiency in *any* plant where water is used.

Whether you are planning a new plant, or modernizing an old one, call on Nalco for water treatment chemicals and services that consistently produce outstanding results.

Top photo: Unusual modern architecture of St. Louis Municipal Airport Terminal Building is expandable in any direction. New units (dotted lines), can be added readily when required. Services buildings, *upper right*, are built and equipped with future expansion in mind. *Photo by Lloyd Spainhower.*

Lower photo: Nalco Chemicals and Services protect both boiler and cooling water systems at new St. Louis Airport. In this photo a Nalco cooling water treatment, supplied in ball briquette form, is being applied through the convenient Nalco feeder.

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THE Nalco® SYSTEM . . . *Serving Industry through Practical Applied Science*

Nalco CHEMICALS

For more facts circle 266 on Reader Service card, p 117

Completely New Concept from SCHAUB
In one package you get complete instrumentation, automatic after-cooling and sample cooling, automatic timed pressure flush to maintain high recovery efficiency, individual volume control valves, (with illuminated sight flow indicators), heat exchanger and flash tank. Matching cabinet sink is final touch. All interconnecting piping and wiring are installed. Only service connections need be made.

Ready-to-install Packaged Console for Continuous Boiler Blowdown and Recovery Handles all Functions Automatically

Saves Engineering Time, Saves Installation Time; Gives Maximum Thermal Recovery. It Does Not Forget, Mis-time, "Overshoot" or "Undershoot"

Schaub's continuous boiler blowdown and sampling system helps produce significant boiler room savings. With each operation performed exactly as it should be, when it should be, with no water lost in overflushing or overcooling, reduced costs can be anticipated. Thermal recovery is constant and at a high level. Mantime requirements are less. Space requirements are reduced. This Schaub Automatic Console System needs only field service connections to put it into full operation. Several man-weeks of design time, plumbing, steam fitting and wiring are eliminated.

For those boiler rooms where the fully automatic operation, complete instrumentation and cabinet design of the Schaub Console system may not be desired, Schaub can provide a ready-to-install "basic" system which provides all the functions of continuous blowdown, but under manual control.

Two, three or four boilers can be handled; either 250 pound or 600 pounds WSP. Capacities to 6000 lbs./hr. total blowdown. To learn further details on Schaub Systems for continuous Boiler Blowdown, mail the coupon below.

Please send me, without cost or obligation, my personal copy of your Bulletin 8001 on Continuous Boiler Blowdown.

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Free literature

Begins on page 117A

bulletin 102. Appendix includes discussion of preparation of solutions for cleaning. Chas Pfizer & Company, Inc

187 **Ultrasonic cleaning** is subject of 4p bulletin 16A. Explanation of method and compounds used is included. Oakite Products, Inc

188 **Rust and corrosion control** is topic of 36-p systems catalog. Discussion of control by colorful protective coatings is feature. Info on surface preparations, application techniques, 110 color chips to show actual colors are included. Rust-Oleum Corp

189 **Metal treatment** which stops rust, acts as bond between metal and paint is introduced in 4-p bulletin. Rusticide Products Co

190 **Pulling systems,** rams, pumps and hydraulic presses are topic of new 24-p industrial maintenance catalog p-g. "How to" photos are included. Owatonna Tool Company

191 **Power-plant repairs** are subject of brochure describing firm's facilities and equipment. Arthur Tickle Engineering Works, Inc

VALVES AND FITTINGS

192 **Solving piping - flexibility** problems with ball joints is subject of 8-p bulletin 31-A. Photos, diagrams are given with explanation. Barco Manufacturing Co

193 **Single control valve** for zeolite softeners, ion-exchange units and filters is detailed in 4-p bulletin WC-122. Graver Water Conditioning Company

194 **Rubber - seated butterfly** valves for hydrostatic pressures up to 125 psi and velocities up to 16 ft per sec are featured in 36-p catalog. Darling Valve & Manufacturing Company

195 **Flexible coupling** is detailed in 4p brochure. Specs, rating capacities, selection info are included. Van Gelder Mfg Co

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Construction of a 200,000-kw steam-electric plant for Pacific Gas and Electric Co will start between 1962 and 1965. Plant will be powered by nuclear fuel.

For more facts circle 267 on Reader Service card, p 117

circle 268 on Reader Service card, p 117

METALLIC AND FIBROUS PACKINGS FOR EVERY PURPOSE

"TAURIL"

Tauril Sheet is an excellent gasket material for superheat and other services requiring an especially strong and tough gasket. Used wherever temperatures and pressure are high —up to 750° F.

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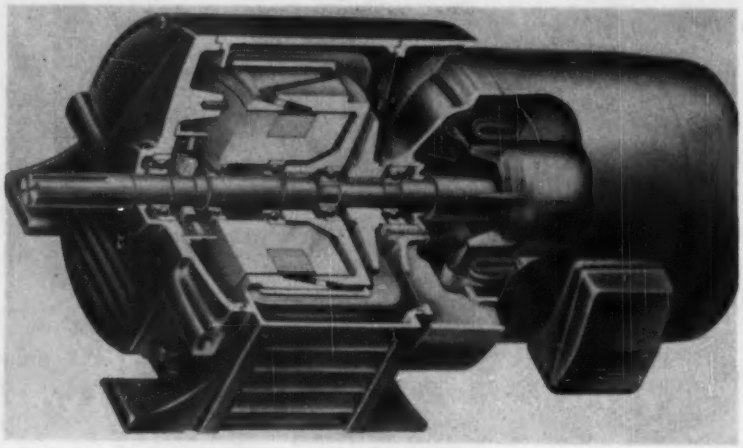
● FIBROUS AND METALLIC PACKINGS FOR EVERY INDUSTRIAL PURPOSE

For more data on these developments, circle key numbers on Reader Service card, p 117

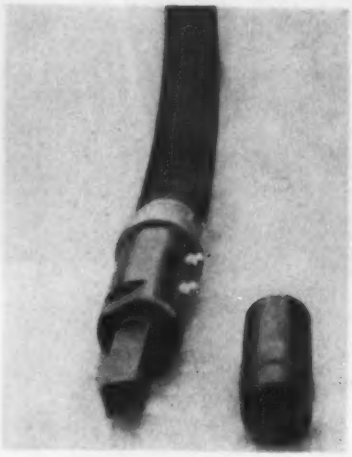
Plant equipment news... Your



◄— Drive features simple design, few moving parts

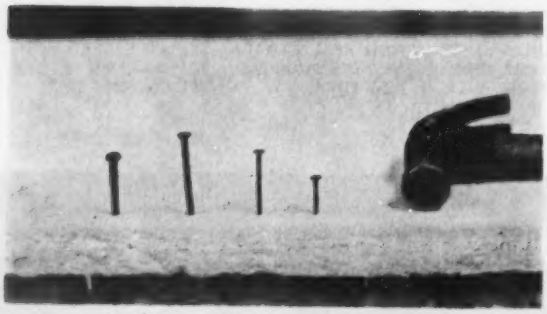
1 • Stepless adjustable-speed drive is offered as complete package. It includes drive unit, control enclosure with control for both coupling and integrally mounted ac motor and operator's station. Wide speed range includes ratings through 20 hp with capacity for continuous operation down to 100 rpm at rated torque providing a speed range of approximately 17:1.

Eddy-current coupling units have bearings arranged for positive gap alignment and to simplify disassembly and reassembly. Bearing loads are sharply reduced for longer bearing life. Coupling field coil and tachometer generator are stationary, with no brushes or slip rings. Windings are completely encapsulated in epoxy resin for positive protection, maker says. Low-maintenance 2-coil high-frequency design features simplicity and higher voltages to eliminate need for voltage amplification. Control enclosure is front wired. Exciter-regulator has plug-in component board for quick replacement. Units are available from 5 to 100 hp with ratings delivered at output shaft of coupling.—General Electric Company



◄— Shaft transmits up to 1650 in.-lb torque at 500 rpm

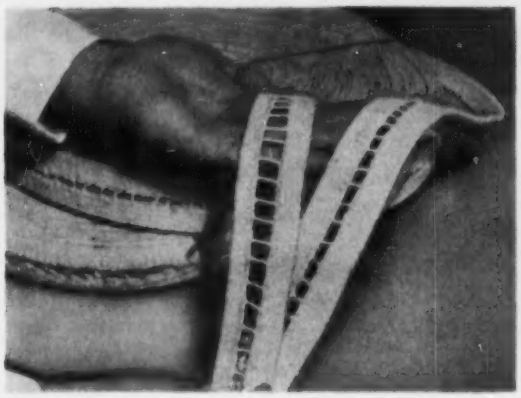
2 • Extra-heavy-duty power-drive flexible shafts are designed to transmit large amounts of rotary power over any curved path, says maker. Heavy-duty core is made up of layers of tightly wound music wire; casing is lined with oil-tempered spring steel reinforced with wire braid. Abrasion-resistant jacket is oil-resistant neoprene-impregnated fabric. Shaft with 1-in.-dia core transmits up to 760 in.-lb of torque at 600 rpm. —Stow Manufacturing Company



Insulation has light weight, strength

3 • Incombustible asbestos board can be used for ductwork, firewalls, fireproofing structural material, heat screens and h-t test chambers, among other applications. It can be worked like wood—sawed, planed (to .001 accuracy), sanded or drilled, and it holds nails or screws. Structural properties should not be affected by immersion in water. Compressive strength of 2400 psi is obtained with 35-lb density. Board is available in 1- to 3-in. thicknesses.—Union Asbestos & Rubber Company

information center for new products and materials



Gasketing tape has bolt-space openings

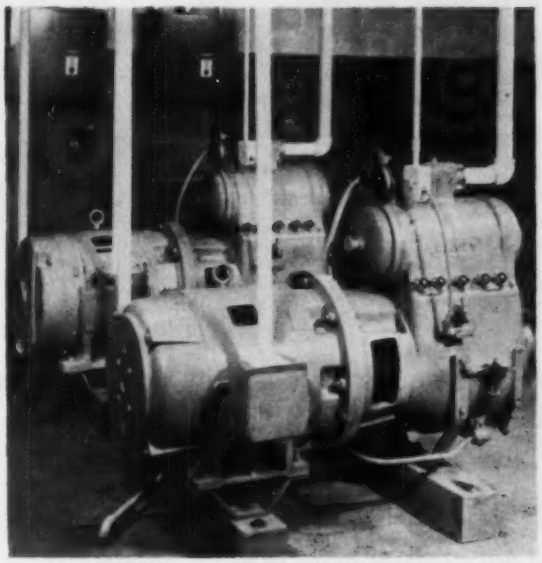
4 • Double-seal asbestos gasket tape eliminates two separate gasket applications on sides of bolts or studs. Tape is wire inserted with open lattice, woven flat to desired dimensions, or plain woven nonmetallic asbestos. Lattice work or bolt-space openings make it unnecessary to perforate tape beforehand. Openings and overall thickness vary in size. Tape can be plain or graphite coated. —Union Asbestos & Rubber Co, Fibrous Products Div

Blower wheels claim corrosion resistance

5 • Porcelainized wheels are designed for process and air-conditioning equipment, cooling towers, evaporative condensers and other applications where corrosion or abrasion may exist, says maker. Only minor traces of rust were left on wheel blades after 1000-hr salt-spray test—most of these spots wiped off. Sizes of glass-coated wheels range from 10 to 20 in.—Morrison Products, Inc

Dredge package is designed for solving small-suction job problems

6 • Small-suction dredge should solve problems of removing mud, silt, sand, or gravel from water-supply areas. It is available with 6-, 8- or 10-in. pump. Unit comes complete with V-belt drive, gas or diesel exhaust primer, your choice of gasoline, diesel or electric power unit. Complete unit is mounted on structural-steel subbase, has gages, pump fittings.—Morris Machine Works



Compressor boasts easy installation

7 • No complicated engineering, special machinery rooms or foundations needed with this new unit, says manufacturer. Compressor is completely enclosed, has no exposed belts or couplings. There are just half the working parts needed by conventional units of similar capacities. Lightweight and compact, compressor is said to be quiet and vibrationless.

Units come in hp ratings of 20 to 125 (40-hp unit pictured above) and operate at 100 psi. They are 60-in. long, 26-in. wide, and 40-in. high. Weight is 1600 lb. Users can specify air-cooled or water-cooled models. Only a small outlet is needed to discharge low-temperature air at 180 F—a substantially low temperature for a compressor.—Davey Compressor Company

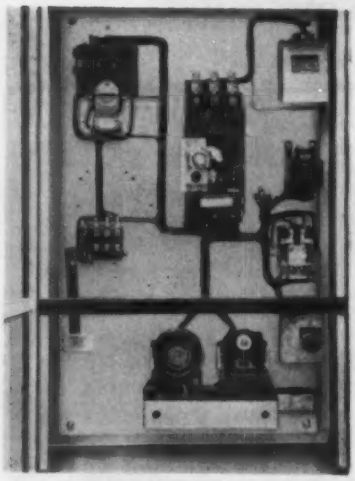
Graphite modules boast separation efficiency

8 • Modules for separation of entrained liquids from corrosive gas streams are designed for high collection efficiency and low pressure drop. Modules are made of corrosion-resistant graphite. Unit operates on principle of impingement, comes in two styles — single-row entrainment or with gutter and downcomer. Staggering prevents straight-through flow. — Union Carbide Corp

For more data on these developments, circle key numbers on Reader Service card, p 117

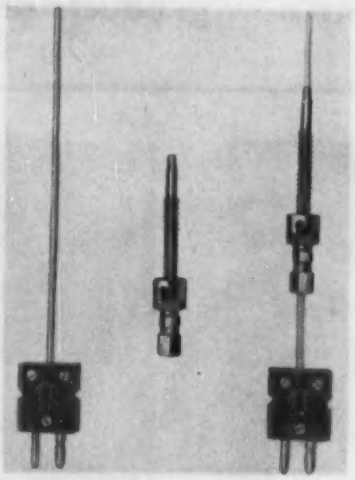
More **equipment news**

For more data on these developments, circle key numbers on Reader Service card, p 117



Control for pump motors

9 • This unit is designed to control and protect 3- to 100-hp squirrel-cage motors that drive oil-well pumps. Controller with 3-phase 60-cycle 220/440-v-ac rating has 3-pole relay for protection against locked rotor, single-phase starting and running and normal overload, according to maker. It comes with lightning arrester and circuit breaker. Operation is automatic.—Westinghouse Electric Corp



Adapter adjusts thermocouple

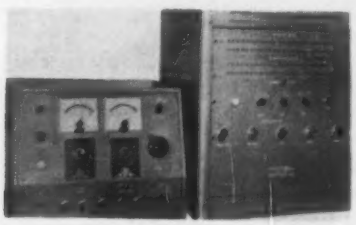
10 • Measuring temperatures at varying immersion depths with fixed immersion thermocouple is possible with this adapter, says maker. Unit allows user to adjust metal-sheathed tubular type thermocouple to spring-loaded thermocouple with any desired immersion length from 1-in. min. It is made of stainless-steel sheath, nickel-plated brass compression fittings.—Thermo Electric Co

Silent valve cuts aeration, vibration, noise

11 • New silent valve is said to eliminate undesirable physical phenomena associated with rapid flow of fluids—aeration, cavitation, surging and resultant noise. It has flow passages which are axially aligned holes in a cylindrical plug of elastomer. Plug is located in tubular housing between two perforated plates, one of which is either mechanically or hydraulically actuated to compress elastic insert.

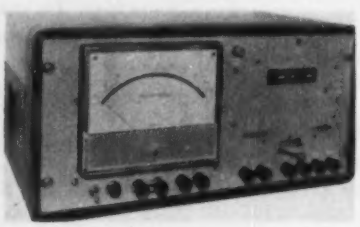
When plug is compressed, flow passages are reduced in diameter, throttling fluid flow. At full compression, channels close and there is complete shutoff. When valve is wide open fine gradations of throttling resistance assure precision flow, says maker. Fluid friction within large number of small-diameter flow passages dissipates energy of large pressure drops.

Valve is available in line sizes from one in. to many feet in diameter and can handle a wide variety of fluids including water and petroleum products. — Aerojet-General Corporation



Tester handles 50 units

12 • Automatic tester makes h-v breakdown tests on as many as fifty units at one time and operates for periods up to 12 hr. Insulation-life tester individually and simultaneously checks motors, capacitors, cables. Suggested applications include incoming inspection and maintenance testing. — Associated Research, Inc



Wattmeter resolves low factors

13 • Electronic wattmeter is designed for measurements at sustained accuracy and resolution down to .01% of rated input, according to manufacturer. Low - impedance - dc output also allows unit to actuate digital meters, drive strip-chart recorders. Wattmeter's range is 250, 500, 1000 w. — Daystrom, Incorporated.

Regulator handles gas temperatures to 450 F

14 • Dome-loaded design of regulator uses gas rather than spring-loaded diaphragm. According to manufacturer this reduces pressure variation by causing less spring-rate effect. Unit is said to be adjustable from 200 to 2500 psig while maintaining accuracy of ±5% of dome load. Regulator body is made of corrosion-resistant steel, sealed with metal seals and isolated from aluminum-alloy dome by heat-dissipating finned section. Weight is 11 lb. Unit is suitable for 450-F-nitrogen regulation. Removable seat and packing allow use with other gases and operating conditions.—Western Sky Industries

For more data on these developments, circle key numbers on Reader Service card, p 117

User-tested NOTTINGHAM Multi-Arc Welding Systems let you...

"Building block" system with rugged, compact, interchangeable units, all engineered specifically for economical multi-arc welding. Proven through more than five years' use in heavy construction and fabrication by industry and government agencies.

...Cut power equipment costs as much as 52% One transformer-rectifier powers as many as 30 arcs... variable resistors permit individual operator control. We can show you that a multi-arc system for 120 operators, for example, costs as little as $359 per operator, against $755 for a comparable single-operator installation.

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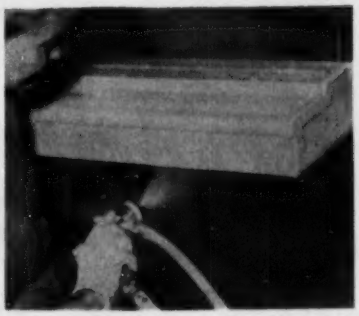
HEV-E-OIL commercial-industrial burners operate on the principle of low-pressure air atomization and furnish *all the air necessary for complete combustion.* This assures efficient, economical operation — perfect fire control regardless of weather or draft conditions. And HEV-E-OIL burners offer you *double savings!* They are especially engineered to make use of inexpensive heavy oils — number 4 and 5. Number 6 or Bunker C in larger models. Available from 5 to 150 gph.

HEV-E-DUTY POWER GAS BURNERS meter air in perfect proportion to the amount of gas used — high efficiency regardless of uncertain stack draft. HEV-E-DUTY COMBINATION GAS & OIL BURNERS offer fuel-proof changeover from gas to oil — in most models just a flip of a switch makes the change. Capacities from 720,000 to 21,000,000 Btu.

These fine burners offer many other sure-fire features! Complete package! Low-fire start! Fire tested! Completely automatic! Meet all codes! Safe, electronic controls! Simple installation! Send for free bulletin. Write Industrial Combustion, Inc., 4507 N. Oakland Ave., Dept. P-20, Milwaukee 11, Wis.

INDUSTRIAL COMBUSTION INC.

EXECUTIVE OFFICES: 4507 N. OAKLAND AVE., MILWAUKEE 11, WIS.



Fluorescent fixtures

41 • Fixtures have acrylic-base finish to provide maximum reflectivity and light output. Enamel resists stains and is said to prevent excessive discoloration of fixtures when exposed to ultra-violet light. Fixtures also resist chipping and scratching, says maker.—Edwin F Guth Company

Cleaner-oiler

21 • Unit cleans and oils pneumatic tools without manual dismantling. It is especially useful in rejuvenating pneumatic tools that are difficult to dismantle for this reason. Cleaner-oiler uses a solvent and lubricating oil carried in cylinder of unit. Normal plant air provides pressure to force solvent through cleaning tool. Weight is 30 lb.—The Marindus Company

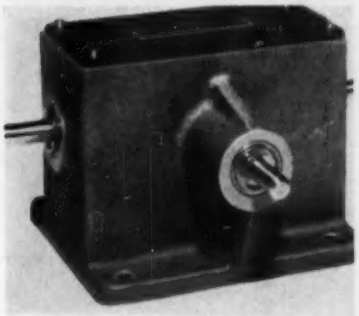
Just circle key numbers on the Reader Service card, page 117, to get complete product story

Proximity switch

34 • Proximity limit switch is self-contained in 10 cu in. hermetically sealed brass housing. According to maker, it is impervious to coolants, abrasive dust, dirt and temperatures ranging from –50 to 250 F. Unit operates without transistors, tubes, coils

Begins on page 130

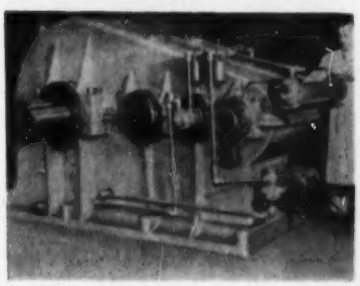
relays or amplifier. It has only one moving part and requires no power input.—General Equipment and Manufacturing Company



Bevel gear boxes

19 • "BA-5" type units come in complete heavy duty range. Shaft sizes are ⅛ to ¼-in. in diameter with variable shaft outputs and inputs. You can have either ball bearing or oil-less bearings or both.—PIC Design Corp

Just circle key numbers on the Reader Service card, page 117, to get complete product story



Helical speed reducers

27 • Quadruple-reduction helical speed reducers with precision-ground gearing feature minimum noise, vibration and backlash, according to manufacturer. Units are available in ratios of 106:1 to 650:1, are rated 815 hp.—Philadelphia Gear Corp

continued

EVERY ENGINEER will want these FACTS!

NEW EDITION
Bulletin No. 31-A

"HOW TO SOLVE

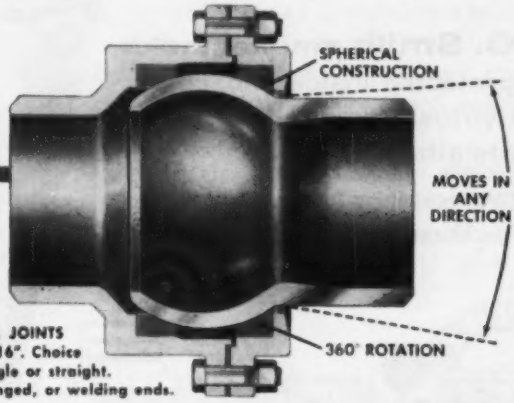
PIPE EXPANSION

PROBLEMS"

TODAY there is an easier way to accommodate *thermal expansion* in piping! No need to install special devices—in virtually every instance, you can put *flexibility* right in the line itself with standard BARCO BALL JOINTS:

1. **SUPERIOR METHOD.** New Steam Power Stations . . . Oil Refineries . . . Chemical Plants . . . Paper Mills . . . Office Buildings . . . Schools now are using this money-saving method.
2. **LONG LIFE.** No rubber, no thin metal members subject to fatigue or "blow-out." No lubrication, no grease packing. Self-adjusting; pressure sealing.
3. **FIRE-SAFE.** The joints have passed rigid fire, high temperature, and water quench tests.
4. **SAVE SPACE, CUT COSTS.** No pressure thrust—expensive anchoring or bracing not required to hold piping in place or in line. Cuts space required for pipe loops and U-bends.
5. **VERSATILE.** Easy to handle compound twisting movements, wide variations in temperature and pressure—steam, air, oil, water, gas and chemicals.

SEE your Barco Representative for information or write. Ask for the new revised Bulletin No. 31-A, "How to Solve Piping Flexibility Problems." *Engineering recommendations on request.*



BARCO BALL JOINTS
Sizes ½" to 16". Choice of styles, angle or straight. Screwed, flanged, or welding ends.

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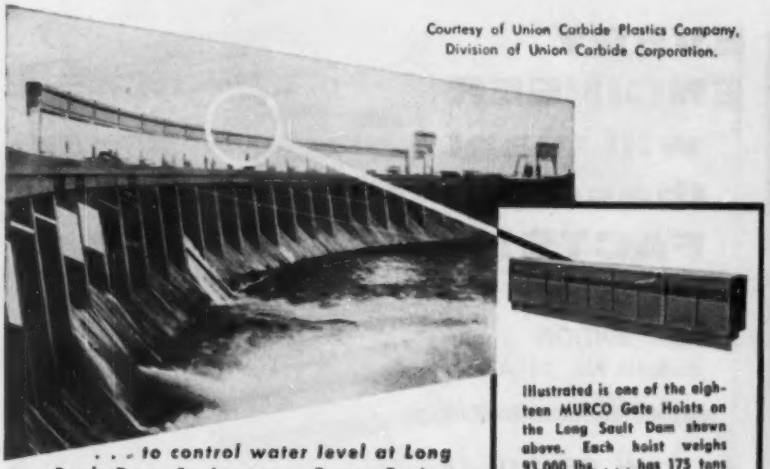
BARCO
FOUNDED 1908

BARCO MANUFACTURING CO.
522C Hough Street • Barrington, Illinois

The Only Truly Complete Line of Flexible Ball, Swivel, Swing and Revolving Joints
In Canada: The Holden Co., Ltd., Montreal

For more facts circle 271 on Reader Service card, p 117

Courtesy of Union Carbide Plastics Company, Division of Union Carbide Corporation.



. . . to control water level at Long Sault Dam, St. Lawrence Power Project

MURCO GATE HOISTS

For the second largest hydroelectric power plant in the United States at Massena, New York—as part of the St. Lawrence power project—Uhl, Hall & Rich, project engineers, selected MURCO Gate Hoists to control the water level at Long Sault Dam. MURCO Gate Hoists are designed from knowledge and experience . . . backed by over 75 years in design and manufacture . . . made for any size power dam . . . capacities from less than 1 ton to over 100 tons . . . from the smallest hand operated to the largest motor operated gate hoist, all made to specifications.

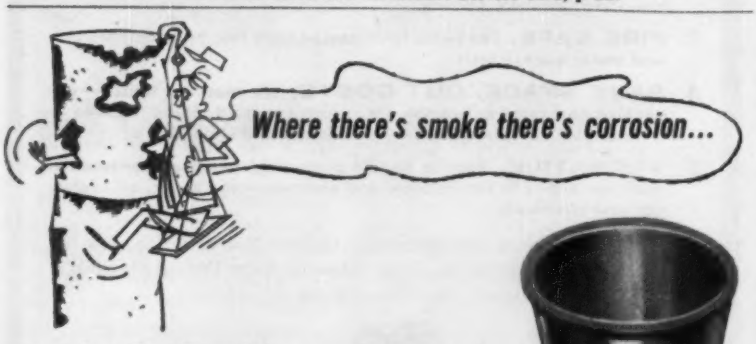
Illustrated is one of the eighteen MURCO Gate Hoists on the Long Sault Dam shown above. Each hoist weighs 93,000 lbs. . . . has 175 tons lifting capacity . . . will raise and lower the gates in the dam at a speed of 1 foot per minute. The overall length of each unit is 57 feet . . . 8½ feet wide and 12½ feet high. Write for complete information and Engineering Department recommendations.

Manufacturers Since 1883

MURCO

D. J. MURRAY MANUFACTURING CO.
WAUSAU, WISCONSIN

For more facts circle 272 on Reader Service card, p 117



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—glass-protected inside and out—are virtually impervious to condensate attack

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SMOKESTACK SALES • PROCESS EQUIPMENT DIVISION
P. O. Box 584 • Milwaukee 1, Wisconsin

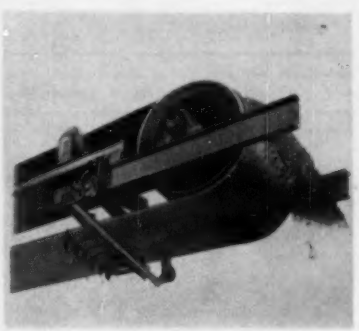
For more facts circle 273 on Reader Service card, p 117

Equipment news

Begins on page 130

45 • Conveyor belt has 45 deg idler design to increase carrying capacity. Equipment is narrower and thus saves space but also initial cost since loads hauled on wider belts can be hauled on this equipment. According to manufacturer there is less spillage, less wear on the belt.—Raybestos-Manhattan, Manhattan Rubber Div

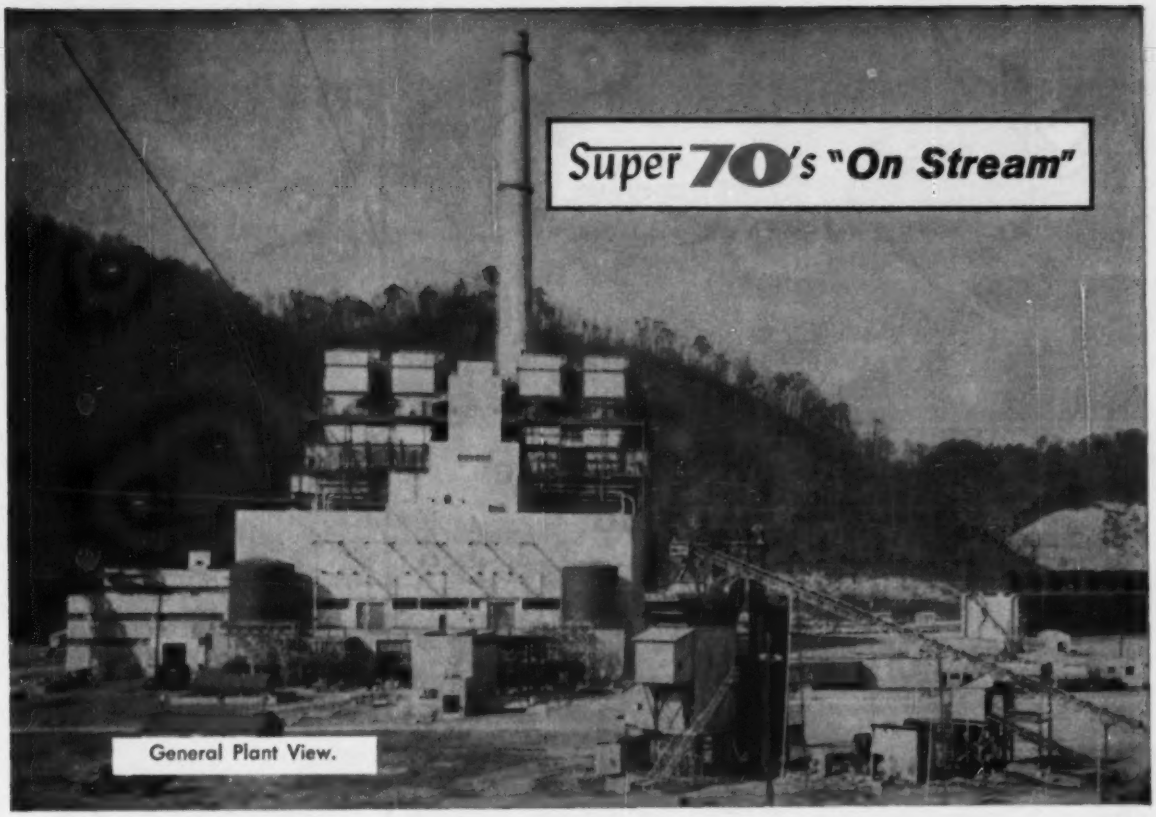
Just circle key numbers on the Reader Service card, page 117, to get complete product story



Belt cleaner

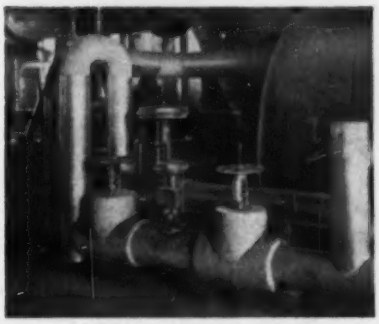
31 • Row of thin, spring-steel-wiper blades with individual pressure springs catch dirt from conveyor belt as it moves along blades. Pivoted connections between overlapping blades permit them to fit uniformly against belt and clean evenly, says manufacturer. Cleaner is said to remove material which would otherwise be ground into belt and to eliminate messy dribble. — Stephens-Adamson Manufacturing Company

continued

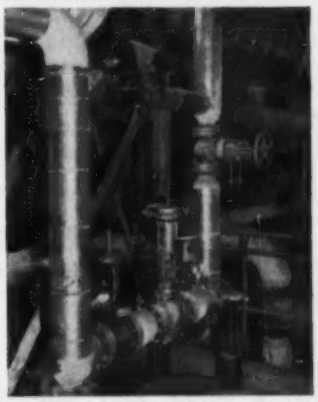


General Plant View.

Clinch River Plant, Units 1 & 2



High Pressure Heater Drain To Deaerator.



Number 4 Heater Level Control Valve.

Highlighting the vast power expansion program of the American Electric Power System, two additional 225,000 KW steam-electric generating stations were recently put on the line by the Appalachian Power Company.

In these fully automatic reheat stations, BS&B Super 70 Control Valves, together with BS&B Liquid Level, Pressure and Temperature Controllers, are employed in heater drain and other auxiliary control systems.

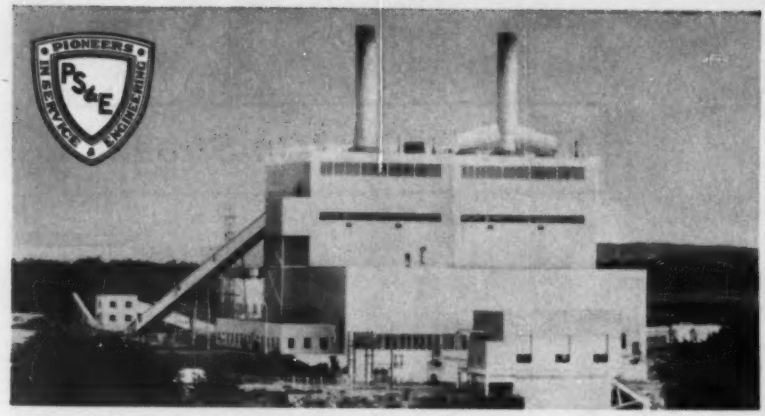
Engineering service, including preliminary engineering studies, multi-load analysis and start-up assistance were provided with BS&B Controls in the Clinch River Plant to assure unit responsibility as well as efficient and dependable system performance.

In the two world's-largest forthcoming 450,000 KW super-critical once-through stations, BS&B Controls will again render proud service to the Power Industry through the American Electric Power System.

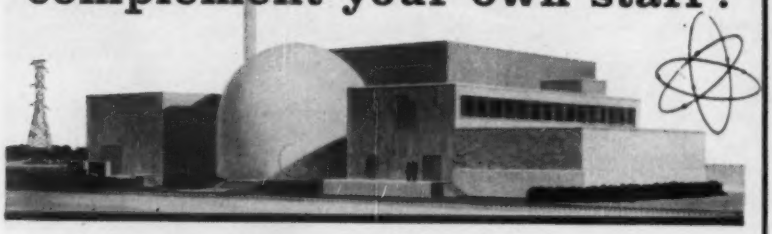
BLACK, SIVALLS & BRYSON, INC.
Controls Division, Dept. 4-Q2
7500 East 12th Street • Kansas City 26, Missouri

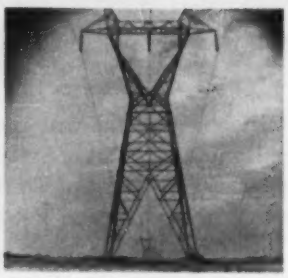
SUPER BS&B 70

For more facts circle 274 on Reader Service card, p 117



Which Pioneer service do you need to complement your own staff?





DESIGN AND CONSULTING ENGINEERING SERVICES

Pioneer specializes in designing power plants and offers design service for fossil fuel, hydro and atomic plants. It will also assist in forecasting load growth, in site selection, in purchasing and expediting of equipment and construction management. Pioneer's other services include substation, transmission and distribution studies and design.

SERVICES IN REGULATORY MATTERS

Pioneer offers its services in all phases of Federal, State and local utility regulation, including natural gas and electric rate matters, certificate proceedings, licensed project accounting requirements, depreciation studies for rate case and income tax purposes, cost allocations and special studies.

CORPORATE SERVICES

Pioneer offers its services as business and management consultants; stock transfer and dividend disbursing agents; financial, accounting and tax consultants.

Write for Booklet "PIONEERING NEW HORIZONS IN POWER"

Serving Electric Utilities and Industrial Power Users Since 1902

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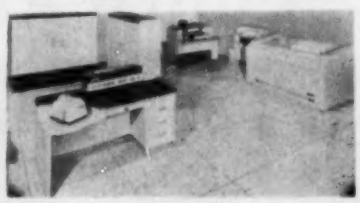
Equipment news

Indoor current transformer

35 • Butyl-molded transformer of 600-v line is specifically for indoor application. Comes with high base or low base bar-type construction with 200, 400, 600 and 800:5-amp ratings. Unit features low price made possible by design simplification and standardization of models.—General Electric Company



Computer system

46 • Solid-state process computer system provides data for on-line operation and analysis, off-line analysis and off-line analysis using on-line data. Stored data constants and operating programs can be modified or corrected while machine is running without disturbing remaining program or stored information. Plain English and decimal system control panel eliminate decoding.—Information Systems, Inc

Just circle key numbers on the Reader Service card, page 117, to get complete product story

Moduline gear drives

37 • Gearing units have output speed of 120 rpm and are especially

For more facts circle 275 on Reader Service card, p 117

Begins on page 130

applicable for use in side entry agitators, according to maker. Ratio of concentric shaft units is 4.17:1 producing output speed of approximately 420 rpm with input speed of 1750 rpm.—Westinghouse Electric Corp

Rectifier-conversion unit

25 • Silicon-rectifier-conversion unit was designed to eliminate maintenance of mechanical rectifiers and replacement of tube type rectifiers on electrostatic-precipitator power supplies. Units are for use in h-v dc power supplies on electrostatic precipitators that collect flyash and dust particles. They consist of silicon rectifier diodes immersed in oil and enclosed in an insulating cylinder. Conversion units are available for use with rectifier transformers rated up to 75,000-v rms and up to 45 kva in full-wave bridge rectifier circuits. —General Electric Company

Just circle key numbers on the Reader Service card, page 117, to get complete product story

continued

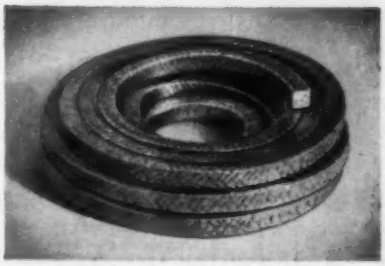
I'm an all-around "PETROLEUM PACKER"

Petroleum service separates the men from the boys in the packing field—but you can count on Allpax Packings for this rugged service. They're the result of extensive laboratory research in the development of suitable packings for service against distillates and petroleum products. Recommended for use on centrifugal and rotary pumps, valve stems, swing joints and similar pumping equipment.

Style No. 14 – For regular petroleum service. Excellent against gasoline, light and heavy oils, benzol, toluol, etc. For temperatures up to 550 degrees F. Compounded of long asbestos fibres, fine flakes of graphite, and a special bonding compound containing an oil-resistant lubricant.

Style No. 13 – For extremes in high and low temperatures.

Style No. 30 – For use against petroleum products at high temperatures and pressures. A very dense packing, made by braiding jackets of asbestos yarn over a center core of pure asbestos content. The jacket is treated with a special heat-resistant compound. The outer jacket is lubricated with a coating of graphite.



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"The Packing that Packs All"

SEND FOR OUR NEW CATALOG — TODAY!

A complete line of packing, tools, gasket materials. Ask for dealer information and price schedules.

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CANADIAN DISTRIBUTORS: Albion Asbestos Packings Ltd., Montreal 8, Quebec

For more facts circle 276 on Reader Service card, p 117

GUARANTEED

to give drip-tight leak-proof seal

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For over 55 years the firm guarantee back of each and every DART UNION sold has been — *"if one should leak through we will give you two"!* The record reveals that less than 1 in every 100,000 has proven to be faulty. The extra wide bronze to bronze seats, precision ground to a true ball joint, mounted in heavy malleable iron pipe ends and protected by an extra heavy union nut, make a drip-tight, leak-proof connection WITHOUT EXCESSIVE WRENCHING time and time again.

Guarantee positive tight connections and extra long service on your pipe lines by using the DART GUARANTEED UNION.

Yours on request: Descriptive brochure on Dart Unions and Union Fittings.

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For more facts circle 277 on Reader Service card, p 117

Babbitt
Adjustable SPROCKET RIM
with Chain Guide
Changes that Danger Zone to a
SAFETY ZONE

The distance between the floor of your plant and your overhead valves is a DANGER ZONE when piled up boxes or even ladders are used to reach the valves.
Turn it into a SAFETY ZONE — equip your overhead valves with Babbitt Adjustable Sprocket Rims with Chain Guides.

- They simplify pipe layout.
- They fit any size valve wheel.
- They are easy to install and operate.
- They operate any valve from the floor.
- They save time and money.
- The first cost is the only cost (no maintenance).
- They are packed completely assembled (one to a carton), with easy-to-follow instructions.
- A hot-galvanized rust proof chain is available for all sizes.

Babbitt Adjustable Sprocket Rims with Chain Guide are carried in stock by most mill supply houses. If your supplier does not carry them, contact us direct.

Babbitt STEAM SPECIALTY CO.
2 Babbitt Square, New Bedford, Mass., U.S.A.

circle 278 on Reader Service card, p 117

More clean water at a lower cost with
SPKINNEY AUTOMATIC SELF-CLEANING
STRAINERS
. . . for efficient removal and disposal of suspended particles from raw or process water and other liquids

- Over 1000 installations
- 2" to 48" pipeline sizes
- Installation on pressure or suction side of pump

Write today for Bulletin 500-1P

S.P. KINNEY ENGINEERS, Inc.
CARNEGIE, PENNSYLVANIA

circle 279 on Reader Service card, p 117

Equipment news

Begins on page 130

Drum-filling cover

39 • New cover eliminates dangerous and costly spillage, says maker. Plastic cover collects and holds overflow due to fill-line breakdowns, leaky valves and careless operators. Corrosionproof cover is available in 15-, 30- and 55-gal sizes and will fit all standard fill lines on steel, fiber and polyethylene drums. Cover is made of unbreakable translucent polyethylene.—Delaware Barrel & Drum Company, Inc

Just circle key numbers on the Reader Service card, page 117, to get complete product story

Enclosed precision switch

50 • Adjustable roller-arm enclosed switch has die-cast aluminum housing, sealed overtravel plunger and adjustable roller-level actuator. Neoprene-gasketed interchangeable side plates and neoprene boot sealed to the plunger make this efficient assembly.

NEW AMESTEAM GENERATOR

MODEL AA

NEW Lower Cost

NEW Oil Burner

NEW Gas Burner

NEW Compactness

NEW Lower Fuel Costs

NEW Lower Maintenance Costs

NEW More Convenient Controls

. . . OLD AMES DEPENDABILITY

The **NEW** Model AA AMESTEAM GENERATOR offers the ultimate in steam generating efficiency and reliability.

The **NEW**ly designed low pressure air atomizing oil burner will cleanly and uniformly burn all commercial grades of oil — #4 with little or no preheat — for more efficient, economical firing. Since electric pumping and preheat loads are lower, power costs are greatly reduced. For gas firing the **NEW** ring type burner provides a more uniform flame pattern for cleaner, more efficient combustion.

All Model AA AMESTEAM GENERATORS are designed to operate at top efficiency over a modulation range of 20% to 100% of rating.

The Model AA incorporates Ames' time-proven 3-pass concentric tube design, single one-piece baffle and one-piece flue covers. Easier access is provided for inspection and servicing. The **NEW** ultra-compact design simplifies positioning and installation. All units are factory-assembled and fire-tested.

Before you buy a package boiler get the facts on the all **NEW** Model AA AMESTEAM GENERATOR.

AMES IRON WORKS, INC.
OSWEGO, NEW YORK

AMES IRON WORKS, INC., Box H-20, Oswego, N. Y.

Please send me full details on the **NEW** AMESTEAM GENERATOR Model AA Package Boiler.

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COMPANY_____

ADDRESS_____

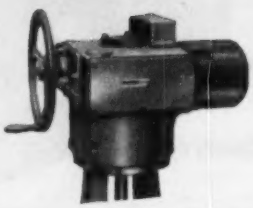
CITY_____ ZONE_____ STATE_____

For more facts circle 280 on Reader Service card, p 117

ARGONNE NATIONAL LABORATORY
WILL USE...

Containment shell of the experimental breeder reactor under construction in Idaho and (above) cut-away showing reactor vessel within the "primary tank."

ELECTRODYNE®
AUTOMATIC VALVE / CONTROLS
FOR EXPERIMENTAL
BREEDER REACTOR IN IDAHO



Electrodyne will be used by the Argonne National Laboratory as the control for the reactor vessel cover hold-down mechanism in the new experimental breeder reactor EBR II at the National Reactor Testing Station near Idaho Falls, Idaho.

EBR II is a "closed cycle" power plant, where nuclear fuel will be employed to produce heat and at the same time make additional fuel by a "breeding" process. The partly spent fuel and the new fuel that has been bred can then be reprocessed and refabricated into new fuel elements right in the EBR II facility.

Electrodyne is an integral part of the EBR II design controlling the hold-down mechanism for the cover of the fuel chamber which will be submerged in liquid sodium. This reactor has been planned to demonstrate the "breeding principle" that more fuel (plutonium) can be bred from uranium-238 than is used up while the reactor is operating. EBR II has been designed to produce usable electricity from atomic energy.

For customer applications, *Electrodyne* thrust limiting features assure positive, automatic control and complete safety in the handling of the most critical materials.

This again illustrates the versatility of *Electrodyne* as a valve-type control for a wide variety of applications in chemical and power plants, oil and gas industries and water and waste treatment installations.

For detailed information about *Electrodyne*, get in touch with your local *Electrodyne* representative or any valve manufacturer.

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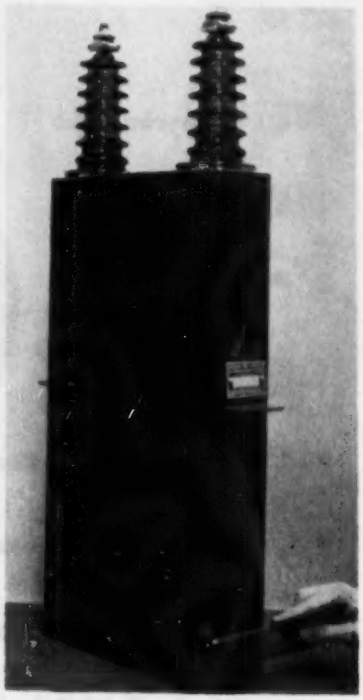
ELECTRODYNE VALVE CONTROLS . . . HYDROID GEAR PUMPS AND MOTORS . . . PRECISION INDUSTRIAL, AIRCRAFT AND MISSILE BEARING AND COMPONENTS

Equipment news

resistant to moisture, dust and oil, says maker. Unit has rating of 20 amp, 125/250/480-v ac and can also be furnished with hp ratings of ¾ at 125-v ac and 1½ at 250-v ac.—W L Maxson Corp, Unimax Switch Div



Lightweight, 50-kvar capacitor

26 • Lightest, smallest 50-kvar capacitor ever available to market is now in production, says maker. Unit weighs approximately 1690 lb and measures 107 in. in length. It will include cast-glass bushings, impregnation with a liquid dielectric, dry-annealed aluminum foil and plated-parallel-groove terminal connectors. —General Electric Company

Just circle key numbers on the Reader Service card, page 117, to get complete product story

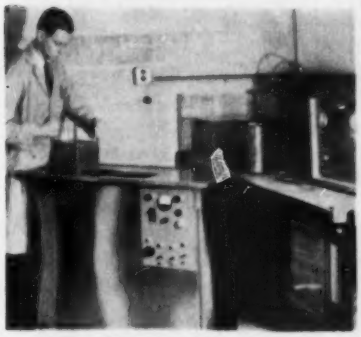
Bus duct

28 • Bus duct distributes high-frequency power with minimum voltage

Begins on page 130

drop and little change in phase relationship, says maker. Maximum voltage drop at 400 cycles per sec is 1.28 v per 100 ft. Duct will operate at frequencies up to 1000 cycles per second.—Westinghouse Electric Corp

Just circle key numbers on the Reader Service card, page 117, to get complete product story



Self-contained degreaser

20 • Ultrasonic degreaser is said to remove metal chips, grease and certain solubles from even intricate parts. Generators, cleaning chambers, rinsing tanks are combined in unit. Only water and 110-v 60-cycle electrical connections are needed outside unit.

Degreaser measures 44x18x36 in. All parts in contact with solvent are made of stainless steel or plastic. Interlocks shut off power when access door is open.—Branson Ultrasonic Corporation

Plastic-tubing insert

44 • Plastic insert should prevent rupture of polyvinyl chloride, polyethylene and nylon soft-plastic tubing when used with brass or steel fitting connections. Tubing insert comes in sizes of ¼, ⅜ and 1 in.—The Weatherhead Company

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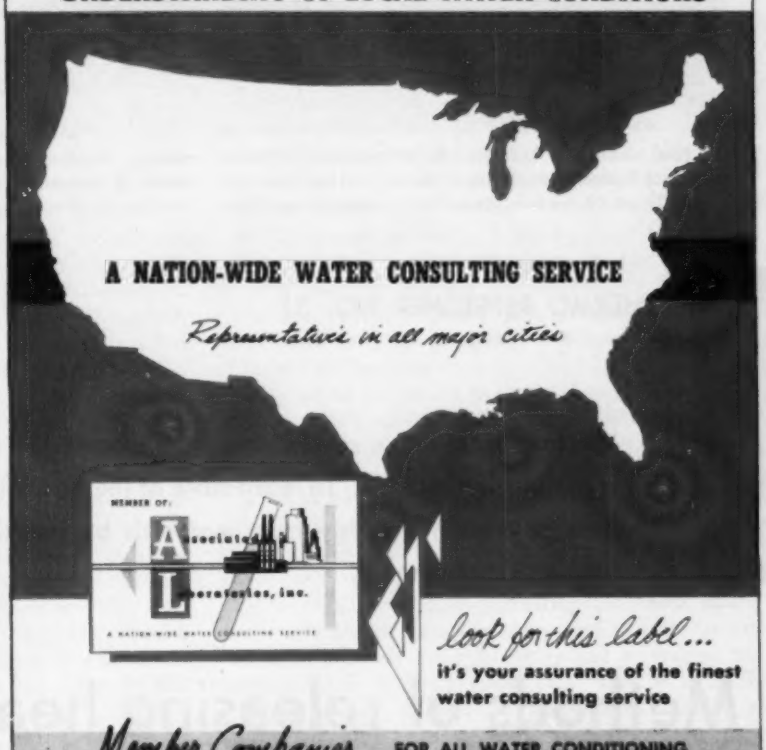
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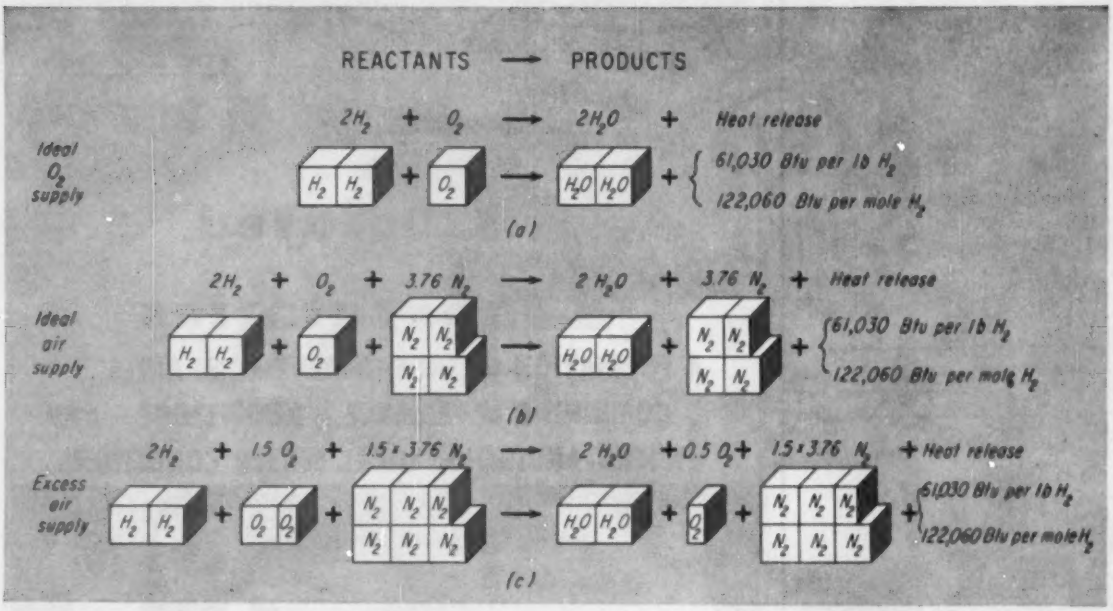

REACTANTS
PRODUCTS
Ideal O2 supply
2H2 + O2 → 2H2O + Heat release
61,030 Btu per lb H2
122,060 Btu per mole H2
(a)
Ideal air supply
2H2 + O2 + 3.76 N2 → 2 H2O + 3.76 N2 + Heat release
61,030 Btu per lb H2
122,060 Btu per mole H2
(b)
Excess air supply
2H2 + 1.5 O2 + 1.5 x 3.76 N2 → 2 H2O + 0.5 O2 + 1.5 x 3.76 N2 + Heat release
61,030 Btu per lb H2
122,060 Btu per mole H2
(c)

1 (*a*) Ideal reaction of hydrogen and oxygen produces water vapor and highest heat release of known common fuel elements. (*b*) To get oxygen from air we have to bring nitrogen into reaction. Nitrogen passes through unchanged, doesn't affect heat release of hydrogen. (*c*) Most actual reactions need excess air to insure burning all the fuel; this puts oxygen in the products

THERMO REFRESHER NO. 35

By B G A SKROTZKI, Associate Editor

We take most of our source energy as transferred heat from a combustion process. To learn more of the basics and problems of creating energy from materials by chemical reactions let's study the . . .

Methods of releasing heat from fuels

Last month, in Part 34, we began talking about the basics of combustion—its chemistry, mole relations and mass relations. As the formulas showed, combustion is an oxidizing process—the chemical combining of oxygen with the burnable elements in the fuel to release internal energy that can be tapped and transferred as heat to energize a power cycle.

We noted that ordinarily we get our oxygen supply from the air, so we have to pull into the reaction process a large mass of nitrogen that contributes nothing energy-wise. Fig. 1*a* reviews the basic process for burning hydrogen. Each cube represents one mole of the basic *reactants* and the resulting combustion *products*. Products usually have fewer moles than the original reactants, but the individual product moles are heavier than original reactant moles. Total mass on each side of reaction equation must be essentially equal to balance out.

We can give our heat release in terms of Btu per lb or Btu per mole (specifically lb-mole). To get the latter we multiply the Btu per lb by the molecular weight of the fuel element.

Air supply. Since we use air to get our oxygen supply we must know how much is needed to burn up our fuel. Air has 79.0% N_2 and 21.0% O_2 by volume—so for each volume of O_2 needed we also have to take 79.0/21.0 = 3.76 volumes of N_2; or to get one volume (mole) of O_2 we must take 1 + 3.76 = 4.76 volumes (moles) of air. Fig. 1*b* shows this relationship and how the N_2

is unaffected chemically, appearing unchanged on both sides of the equation. The heat release is the same as in 1*a*—we merely have to handle more inert mass in our reaction. This becomes an important consideration in design of boilers and i-c engines.

Experience shows that we rarely can take exact amounts of fuel and air as in Fig. 1*b* and get *all* the fuel elements to combine with the oxygen, leaving nothing on the product side except products and nitrogen. To insure burning all the fuel elements, we must supply more oxygen than needed for the ideal equation. This means supplying an excess of air—an excess of both O_2 and N_2—which results in all of the fuel combining with O_2 and leaving some uncombined O_2 and of course the inert N_2 in the products. Fig. 1*c* shows the relation for an air excess of 50%, or a total air supply of 150%. Again we get only the heat release of the ideal reaction.

Combustion conditions must meet several needs before the reaction proceeds:

(1) Elements entering the reaction must first be heated to ignition temperature. Physically this means that the individual reactant molecules must be speeded up until they have enough energy to collide with each other and combine their electron orbits to form the product molecules. This rearrangement of elements to form new molecules releases the internal energy (by converting a minute amount of electron mass to energy). If the molecules aren't fast enough individually, short-range repulsion forces between molecules prevent them from coming into physical contact, and no reaction takes place.

(2) Once a reaction starts between a mass of fuel and oxygen, enough time must be allowed for the reaction to run to completion. It takes time for the fuel molecules to find free oxygen molecules with which they can combine to form product molecules. Remember there are enormous relative distances between gas molecules. They may pass each other hundreds of times in near misses before they contact. If all fuel molecules met mating oxygen molecules at the same instant we would have explosion instead of smooth progressive burning.

(3) To insure that fuel molecules meet available oxygen molecules the two gases must be thoroughly mixed. Combustion chambers and furnaces must be designed to promote mixing of the gases as they flow through; that is, the flow must be turbulent. Fig. 1*b* and *c* shows that there is a large proportion of inert nitrogen molecules in the gases that will get in the way of fuel and oxygen molecules. They increase the need for turbulent flow.

(4) We already have talked about the need for excess air in completely burning the available fuel. This is a matter of thermal efficiency—fuel costs money while air is free, at most costing a small amount of fan energy to push it into the combustion space. To control thermal efficiency we measure the fuel-air ratio (lb fuel per lb air). This usually has to be lower than the ideal to completely burn the fuel. Excess-air needs depend on the furnace or engine. Range runs from about 5% to as high as 50% (high excess air means low fuel-air ratio); in gas turbines it may run 200% and more to limit temperature rise. Some i-c engines occasionally use a fuel-air ratio higher than ideal (air deficiency) for short periods to develop maximum power output for peaking—at the expense of good thermal efficiency.

This by no means completely discusses the conditions controlling combustion reactions, but we have covered the primary factors. Combustion involves many complex intermediate reactions with intermediate products that we haven't the space to cover here.

Dissociation. Our theory of internal energy of molecules associates the largest portion with the kinetic energy of the molecule as a whole traveling through space, see Part 6, Feb 1957. Other parts of internal energy take the form of internal vibrations of the molecules and their nuclei as well as their rotation on an axis and the spin and orbits of the electrons, see Part 1, Aug 1956.

To start a combustion process we know we must raise the temperature of the reactants to ignition level. As the reaction proceeds we convert mass to energy—as the temperature rise shows. If we try to push the temperature up by forcing in more and more reactants we soon come to a point where temperature stays at a maximum but we get a variety of incomplete combustion products and unburned fuels in the products.

This phenomena is called *dissociation*. It seems that the combustion reaction partly acts in reverse. At high temperatures some of the product molecules absorb energy and break up into constituent atoms, for example:

14,096 Btu per lb $C + CO_2 \rightarrow C + O_2$

61,031 Btu per lb $H_2 + H_2O \rightarrow H_2 + O$

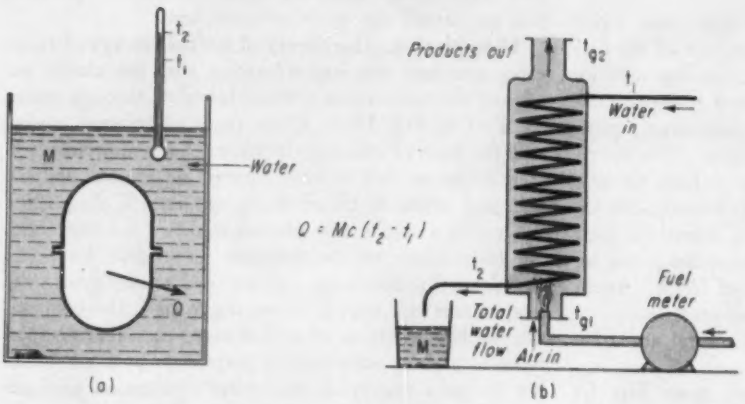
When energy is withdrawn from the burning gases by heat transfer to bring the temperature below the dissociation temperature the fuel elements and oxygen again combine to release energy and form the products of a completed reaction.

Experiments in an i-c reaction showed actual temperature and pressure reached were 4800 F and 600 psia. Without dissociation the maximum temperature should have been 5470 F and the pressure 658 psia.

It seems that above dissociation temperature the product molecules have so much energy in their internal spins and vibrations that the forces holding the molecule together aren't strong enough. So the molecule flies apart into its constituent atoms. Breaking the bonds makes these parts absorb energy in the potential form (reconverting to a minute mass increase) and so reduces the internal energy of the system. This seems to establish a fairly uniform dissociation temperature. Removing energy from the reacting gases by heat transfer may keep energy level low enough to avoid the limiting dissociation temperature.

Heating value of a fuel tells us how many units of energy we may get from it when it is completely oxidized and the products cooled back to the initial temperature of the reactants. We may allow the combustion process to undergo any variety of changes in pressure, temperature and volume, but convenience limits testing to either constant volume or constant pressure.

Constant-volume-process calorimeter uses a "bomb" immersed in a measured amount of water, Fig. 2*a*. The test procedure involves: (1) placing a measured amount of fuel—a few grams—in the bomb (2) forcing oxygen at about 600 psi into the bomb (3) igniting the fuel by an electric spark (4) transferring heat developed by the completely burned fuel to surrounding water (5)



2 (a) Constant-volume bomb calorimeter holds burning fuels under high oxygen pressure and cools them back to starting temperature by transferring heat to water. (b) Constant-pressure steady-flow calorimeter burns fuels at atmospheric pressure to heat a steady stream of water flowing through coils surrounding the furnace

measuring temperature rise — a few degrees — of the water bath. Knowing amount of water and temperature rise we can figure the heat transferred:

$$Q = M \times c\ (t_2 - t_1) \quad \text{Btu}$$

where M = mass of water receiving Q, lb
c = specific heat of water, Btu per lb
t_2 = temperature of water after combustion, F
t_1 = temperature of water before combustion, F

Then the heating value of the fuel is:

$$HHV = Q/m \quad \text{Btu per lb}$$

where m = mass of the fuel sample, lb

This brief explanation gives only the basics of the bomb calorimeter. Actually a variety of corrections for radiation and other factors must be made.

Combustion products within the bomb are essentially cooled to within about 4 F of the reactant initial temperature (this is also the water temperature). This means that any water vapor generated by burning hydrogen in the fuel has been condensed and so contributed its latent heat of evaporation to the fuel heating value.

Constant-pressure-process calorimeter uses a water-cooled coil to absorb heat Q released by the burning fuel, Fig. 2*b*. This unit is used to find the heating values of liquid and gaseous fuels. Test procedure involves: (1) adjusting the water-flow rate through the coil and the fuel-feed rate to the burner to get a constant temperature of combustion gases leaving the calorimeter at above 120 F (2) measuring total water flow and fuel input for a given period of time (3) finding average inlet and outlet temperatures of the water for this period, and average inlet temperature of the reactants and average outlet temperature of the products during this period of test time. This data then is substituted in the above formulas. M is the total water collected during test period, t_2 is the average water temperature leaving calorimeter during the test period, t_1 is the average water temperature entering calorimeter during the test period, m is the total mass of fuel burned during test period.

This calorimeter gives the lower heating value of the fuel if it contains hydrogen. If we keep product temperature above 120 F the water vapor from burning hydrogen does not condense, so it carries its heat of vaporization out of the calorimeter.

Constant-volume bomb calorimeter gives the higher heating value for a fuel containing hydrogen. Standard test temperature for the reactants is 77 F, the base above which the heating value is measured. Theoretically, the difference between higher and lower heating values for the same fuel is the heat of vaporization of saturated steam at this standard temperature. This is 1050 Btu per lb of vapor. One can be calculated from the other if we know the weight of water vapor produced by the burning hydrogen:

$$HHV_h = HHV_l + 1050\ w \quad \text{Btu per lb}$$

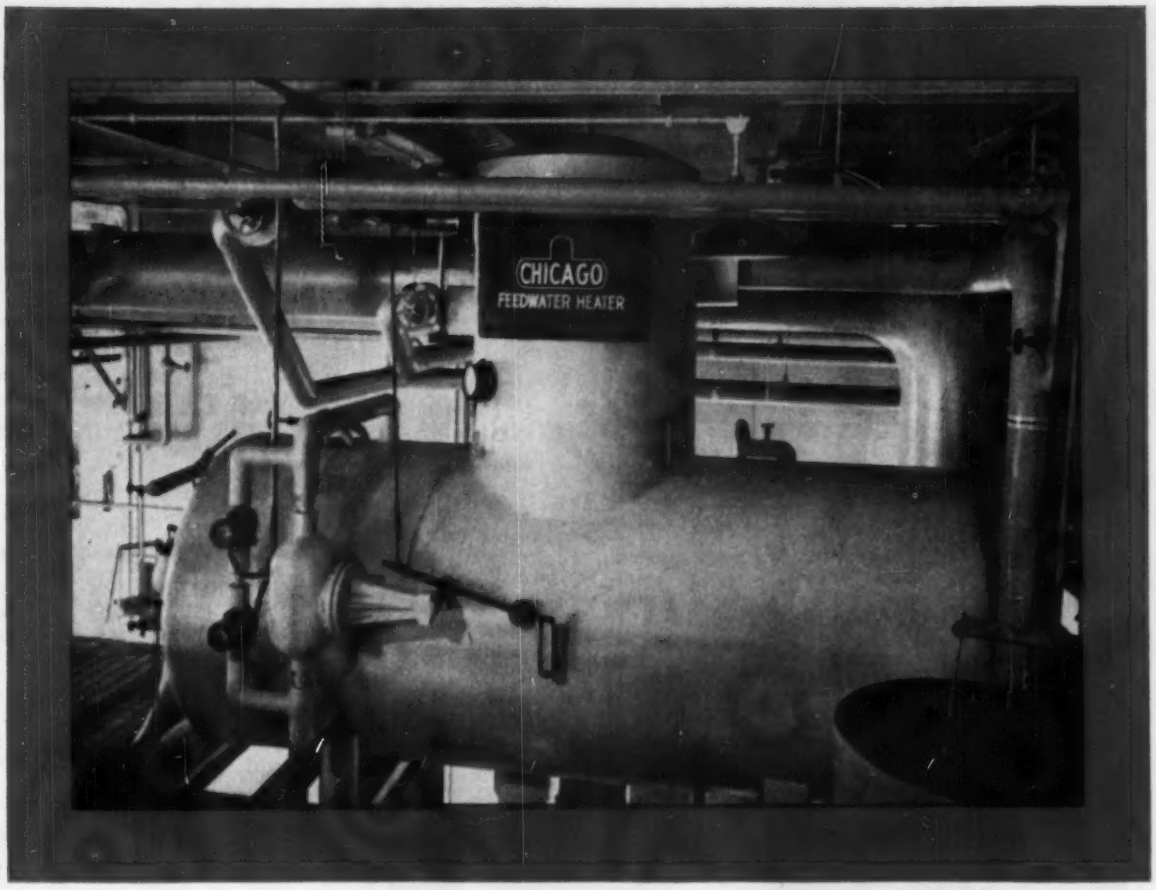
where w is the weight of water vapor per lb of fuel. If we know the weight of H_2 per lb of fuel, then:

$$w = 9\ H_2 \quad \text{lb per lb fuel}$$

When a fuel has no hydrogen it has no higher or lower heating value, but just one that will be measured directly by either type of calorimeter—if the fuel is liquid or gaseous. Heating value of a fuel depends on the temperature used as a base for its measurement. Generally, the lower the base temperature the higher the heating value. Corrections can be made to different base temperatures if we know the specific heats of the reactants and products.

Cycle heat input. Total heat input Q into an actual engine cycle seldom, if ever, equals the heating value of the fuel supplied. Most practical cycles do not have a large enough heat-transfer surface, or cannot hold the combustion products long enough to reduce leaving temperature of the products (flue gas or exhaust) to temperature of the incoming reactants.

Practical engines and cycles have small amounts of unburned or incompletely burned fuels in their products. Limited combustion time, incomplete turbulence, too-rapid cooling and other factors cause this condition. As a general rule we can assume that heat released in



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Thermo refresher

Begins on page 144

a furnace or combustion chamber is less than total heating value of the fuel; in turn the heat input Q to the cycle from combustion gases will be less than total heat released by burned fuel.

Fuel analysis. The practical way to determine fuel heating value is by calorimeter. But knowing the heating value of each fuel element we can also calculate it from an analysis of a fuel, for example:

Fuel element	Weight, %	HHV, Btu per lb	w × HHV
C	70.5	14,096	9938
H_2	4.5	61,031	2746
S	3.0	3984	120
O_2	6.0	0	0
N_2	1.0	0	0
Ash	11.0	0	0
Water	4.0	0	0
Total	100.0		12,804

Next part will start study of thermodynamic vapors—in an upcoming issue.

Pulverized-coal-fired radiant boiler producing 3¾ million lb steam per hr has been ordered for new 1100-mw Thorpe March power station near Doncaster, England.

"Here it is, right in the manual. It's called an exploded view."

COCHRANE TO PURIFY "HOT" WATER AT INDIAN POINT

When the new Indian Point Atomic Power Plant of Consolidated Edison Company of New York, Inc. goes critical, pressurized water in the primary system between the reactor and the steam generators could gradually accumulate radioactive particles.

Cochrane demineralizers have been selected for the important task of removing these contaminants as well as residual boric acid used as an element of control during start-up of the reactor. Other Cochrane demineralizers will be used for purifying water in which spent reactor fuel elements are transported and stored, and for polishing the distillate from the liquid waste evaporator. All units are in inaccessible shielded pits.

Since the resin in the demineralizers will become radioactive, Cochrane engineers made extensive pilot studies and developed the design of remote control resin charging, transport and storage systems.

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In the secondary loop at Indian Point, two Cochrane deaerators with a combined capacity of 2,800,000 pounds per hour will remove oxygen from turbine condensate.

Outstanding fabrication facilities, combined with years of experience in water treatment, make Cochrane a logical source for advanced systems such as Indian Point requires. Cochrane's skills can be just as valuable to the more conventional plant faced with water treatment problems in power generation or processing. The Cochrane representative in your area will be glad to discuss your requirements, large or small.

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Protect steel stacks with corrosion-resistant concrete

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When expanded shale aggregate is used, these linings also provide vital insulation. This keeps stack gases hot and helps maintain better draft for greater operating efficiency. The steel shell will stay cooler, too, extending the life of exterior paint. And these monolithic concrete linings have a lower unit weight, which reduces the dead load on the supporting structure.

Whether gunited or plastered, installation is easy and economical, with concrete reaching service strength in 24 hours. For even greater convenience, manufacturers of refractories offer castables bonded with LUMNITE cement – packaged mixtures ready for use with just the addition of water.

For more information, write Universal Atlas Cement, 100 Park Avenue, New York 17, N. Y.

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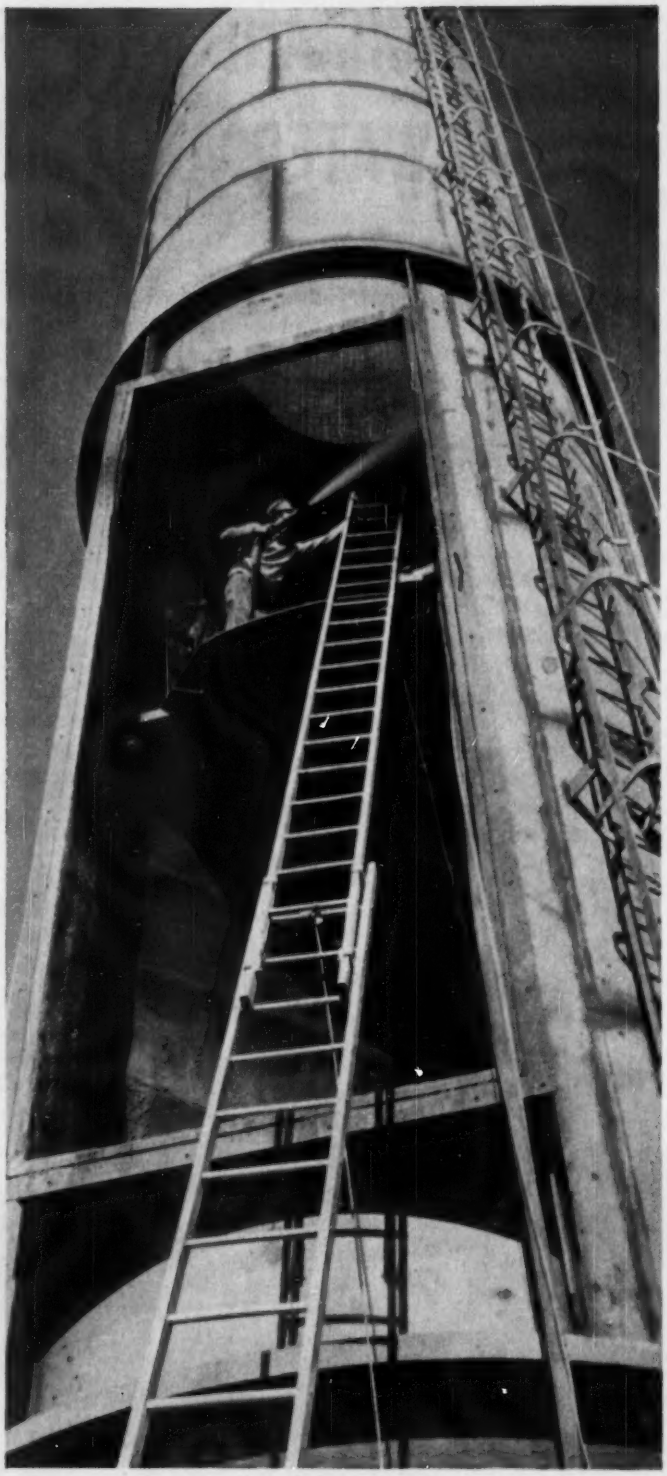

INSTALLATION: Elrama Station, Duquesne Light Company, Pittsburgh, Pa.

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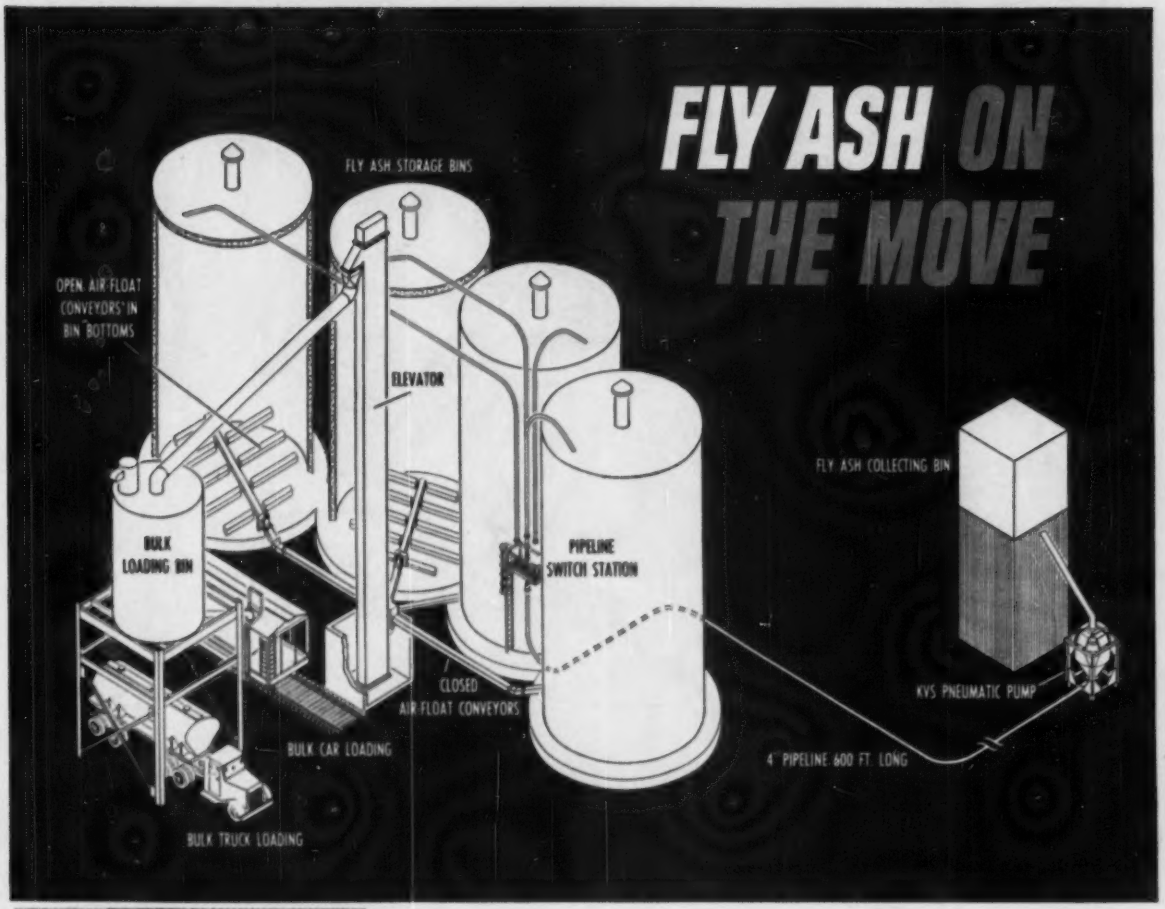

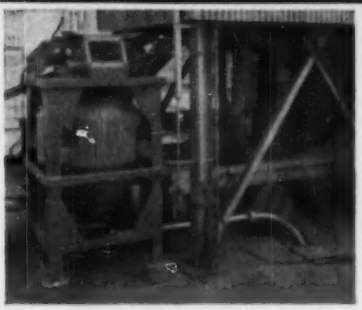

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For more facts circle 288 on Reader Service card, p 117

"I looked straight into that elevator contractor's eyes," roared Marmaduke Surfaceblow, "and heaved the tomcat into his lap."

Marmy's continuous monitor

My phone rang just as Norman Peach placed his 24-p special report, *Electrical Conversion,* on my desk this morning. My old shipmate Jack Millar was on the line. "I just flew in from Miami," said Jack in his delightful Scottish brogue.

"Man, things are really happening today," I yelled into the phone. "Get over to the Bent Propeller Bar by noon, Jack. I'll meet you there with Norm Peach."

When the two of us arrived, Jack already had a table. The place was buzzing as usual. I barged through the crowd and slapped Norm's 24-pager on the bar before that free-wheeling and somewhat unusual consulting engineer and master of all trades, Marmaduke Surfaceblow.

"Here's a damn good report that'll solve many industrial problems," I said, trying to raise my voice above the clanking glasses and guffaws around me. "With dc coming back on the double, this report is full of gold nuggets." Then I quietly pushed my way back to my friends.

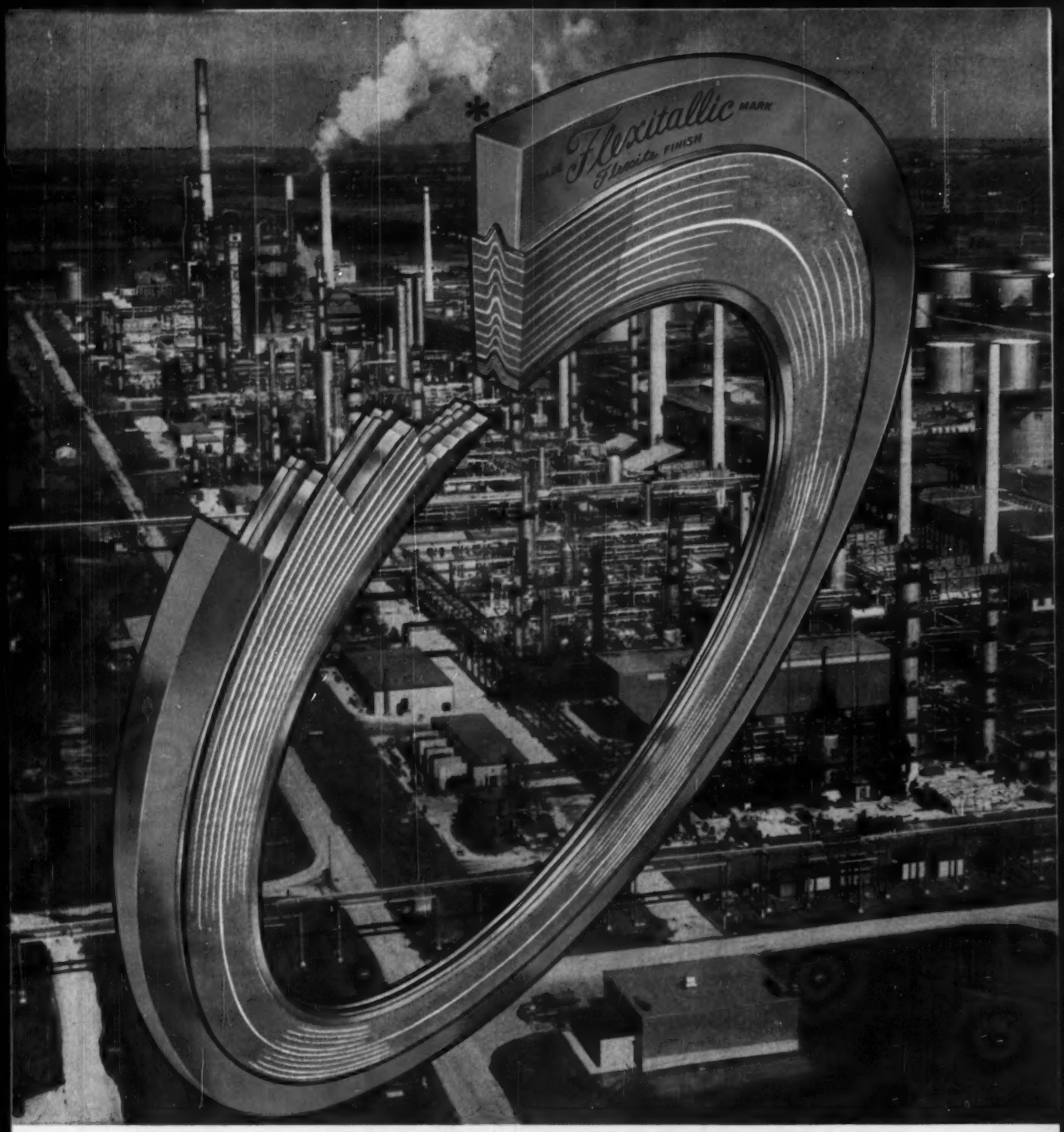
From the table I could see the cantankerous consultant's 6-ft 4-in. frame straighten up to its full height. Then he suddenly grabbed the bottle of Sandpaper Gin before him and revved up his cargo pump. With his double bottoms properly ballasted and his ship in trim, Marmy slammed down the bottle and roared, "BILGEWATER on electrical conversion from ac to dc. I'll tell you kw annihilators how I got the bugs out of two stubborn pushbutton elevators. And all I did was put them on continuous monitoring."

That did it. Suddenly it was like the calm before a hurricane as everyone tuned in to await further developments. I dug into my clam chowder and cocked an ear. Marmy turned to his expectant audience, gave his gray bowler a starboard list, then roared away in his foghorn voice.

"Back in 1955 I was passing the old Produce Building on lower Manhattan's Maiden Lane. Suddenly there was my old shipmate Tim Gilhooley coming out of that building. Tim and I had run a mahogany sawmill in Port Lemon, Philippine Islands back in 1920.

" 'Put 'er there, Marmy, you old walrus!' yelled Tim, slapping me on the back so hard that my hat flew off. Picking up my bowler, I squeezed his hand gently until his ears turned green. Meeting that old shellback sure brought back happy memories. Together we had combed the beaches of the Far East, getting into just about everything that two lusty mariners could find to get into.

" 'Let's step into the bar here and celebrate,' gasped Tim soon as he



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For more facts circle 289 on Reader Service card, p 117

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- ☐ No stuffing boxes or moving parts
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- ☐ "O" ring seals suitable for 400°F.
- ☐ Range of differential pressure adjustment 5 to 45 psi

SEND FOR BULLETIN 1059

ATLAS VALVE CO.
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circle 290 on Reader Service card, p 117

Marmaduke

Begins on page 152

could operate his right flipper again. So while we dissolved the barnacles from inside our filling lines at the bar, Tim informed me that he was chief engineer of the Produce Building. Said they generated their own steam and had just put in a central air-conditioning system. For good measure, they had also converted their old hand-operated elevators to the new pushbutton automatics just six months before.

"'Funny thing about those crazy elevators,' rasped Tim, reaching for a fistful of stuffed olives and washing them down with Sandpaper Gin. 'They're acting as screwy as a frustrated old maid at a sailors' picnic. And nobody can figure out why. Hell, a car gets to a floor, the door closes but the elevator won't start. I lam it down to the motor room and check the fuses and all the gimmicks of the stalled car. Then suddenly she takes off like a scared albatross. Happens every time. Sure is a mystery.'

"'How about the elevator company?' I prodded. 'Can't they find the trouble?'

"'Our service guarantee ran out three months ago,' snorted Tim, digging his claws into the peanut bowl. 'But the elevator company is still trying to master-mind the trouble.'

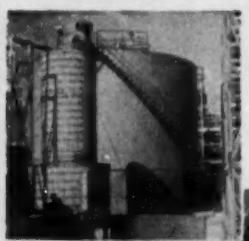
"'I don't claim to know a damn thing about electronic gadgets unless they have steam valves on them,' I piped up, 'but I've yet to see anything mechanical I can't figure out by using a little horse sense.'

"Five minutes later we were next door. The building was ancient, but had been modernized from keel to crow's nest. New main lobby, new floors, acoustical ceilings and new electric fixtures. Everything sparkled like a sea-going luxury liner coming into home port.

"The duplex elevators had tandem gear drums with variable voltage. System was the newest selective-collective pushbutton design that money could buy. Each car had 3000-lb capacity, traveled at 300 ft per minute. Doors on each floor were of the center-parting type. Tim claimed the reconversion came to $75,000,

WHO CHOSE H&T?

For Boiler Feedwater Conditioning Equipment



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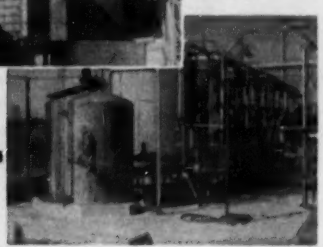

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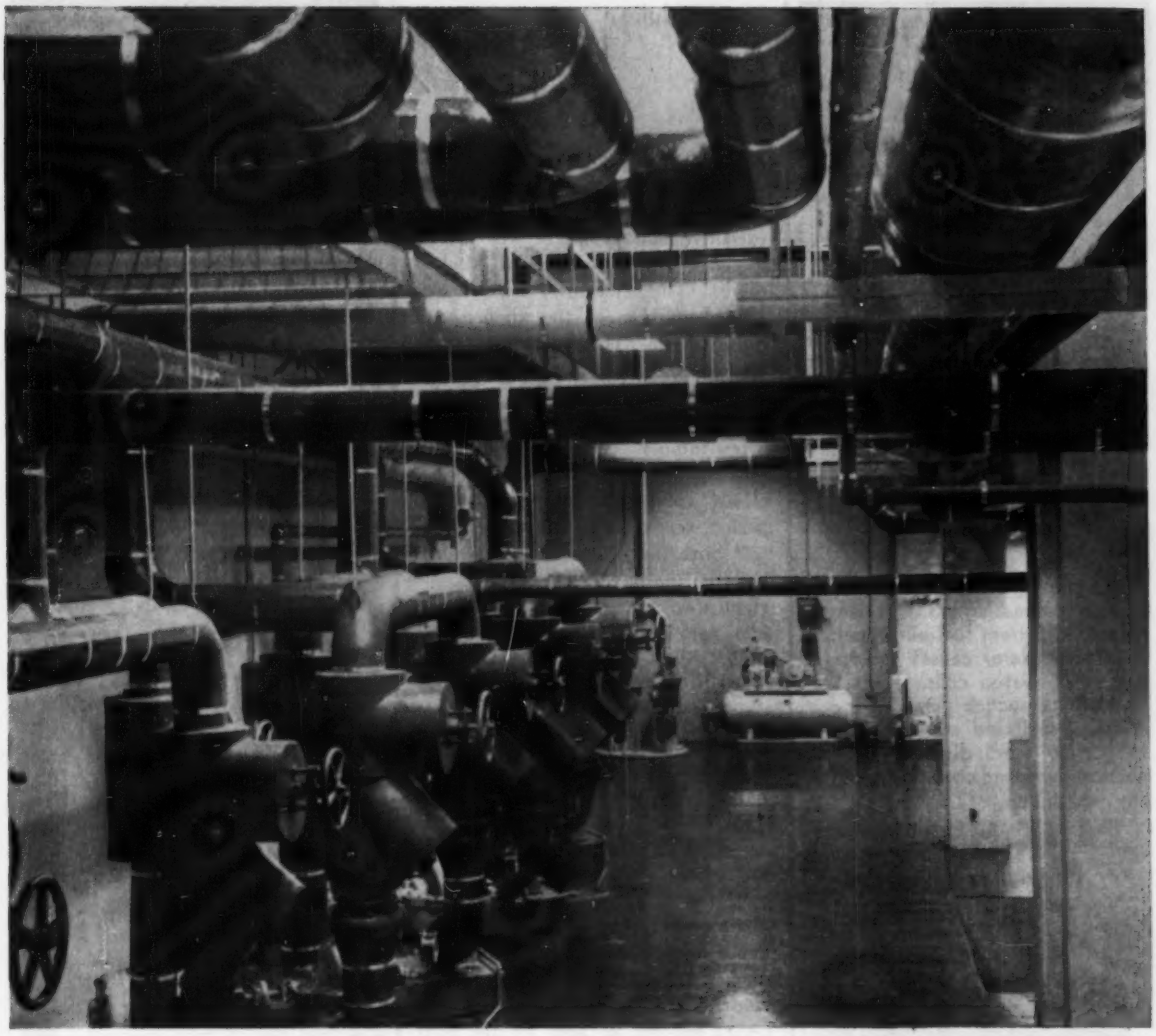

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The product tells you it's safe—USS National Seamless Steel Pipe and Tubes. The designer who insists on USS National Seamless is taking no chances. He wants to safeguard life and equipment, and to stop shutdowns because of unexpected failures.

Seamless shuts out all doubt. From end to end, it's one continuous piece of highest quality steel. No welds. No weaknesses. Absolute uniform wall strength. What's more, when a solid billet of steel is pierced, it's also critically explored. If the billet is successfully pierced, then every inch of the pipe is structurally sound.

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National Tube manufactures seamless pipe and tubes in a complete range of steel analyses from low carbon through the alloys up to and including stainless steel, to withstand the highest pressures and temperatures. A wide variety of sizes and wall thicknesses is available. Plan now to contact National Tube Division, United States Steel, 525 William Penn Place, Pittsburgh 30, Pa.

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Marmaduke

Begins on page 152

but his boss was holding up payments until the cars stopped playing games.

"Street level had high-ceilinged executive suites. There was also a swanky dining room with kitchen there. The elevators were sandwiched in between the kitchen and dining room. The new motor room was in the basement, next to the kitchen storeroom.

"I watched the elevators work for a few minutes. When a car got to a floor the gate would open. Then it closed automatically after a timed period, ready for the next operation.

" 'Sure, both cars are working like children the day before Christmas—right now,' put in Tim, 'but at times one car stalls beyond the timing limit. So I have to drag my hull down to the motor room. But every time I step inside, the switches start clicking and the car starts right up as a shipshape car oughta. Sure is weird,' he continued, shaking his head hopelessly.

" 'Exactly what has the elevator outfit done?' I asked.

" 'Done?' echoed Tim, throwing up his hands in disgust. 'Hell, just about every damn thing that can be done to two respectable-looking elevators. When their troubleshooter comes aboard he tests all the stop buttons, checks the up-and-down circuits and after that he goes over the terminal limit switches and the photoelectric cells. Next he tests the living devil out of the operating relays. And he always ends up by checking the circuits on the governor, the hatchway limits and the cable switches.

"I lit a cheroot. 'Sounds like that's really shooting the works,' I said, rattling my brains into high gear.

" 'Hell,' barked Tim sarcastically, 'if they do any more checking there won't be any elevators left for using.'

"Just then a car floated quietly up and the doors yawned open. The building manager and the elevator contractor stepped out.

" 'How are your playful elevators behaving this week?' asked the manager, looking at Tim. 'Mr Gerber wants his money.'

" 'Well,' replied Tim slowly, 'Gerty

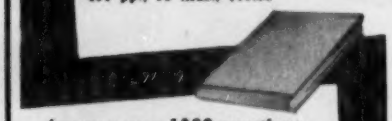
Industrial Instrument Servicing Handbook

JUST PUBLISHED! This new handbook shows you how to service, maintain, and calibrate industrial process instruments and controls easily and quickly. Contains thousands of fully explained and diagrammed working instructions for servicing equipment manufactured by over 40 companies. Plus complete maintenance and repair details for over 80 major types of modern industrial instruments; easy review of fundamentals of operation, testing, and adjustment; and quick answers to hundreds of problems likely to arise in the shop or field. By Grady C. Carroll, Olin-Mathieson Chemical Corp., 848 pp., 375 illus and tables, $16.00

Steam Power Plants

Starting, Testing and Operation

Follows a steam plant from the design and construction stage through the steps preparatory to starting, organizing personnel and facilities, starting up the new plant for the first time, development of operating procedures, and arrangement of test routines. It describes turbines, boilers, auxiliaries, electrical apparatus, water-treating equipment, etc. Covers all classes of steam boilers and steam electric plants, and explains the operation of various pieces of power plant apparatus. By Charles D. Swift, Mechanical Engineer, 490 pp., 95 illus., $11.50



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CLARAGE

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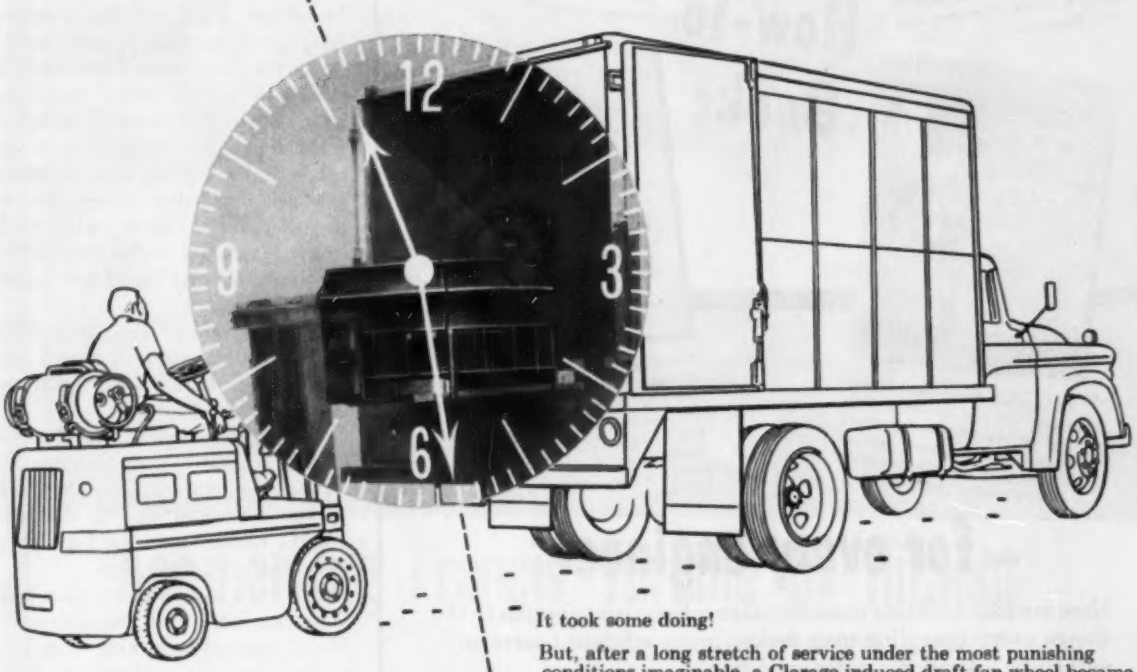

In just 30 hours this Replacement Fan Wheel was built and on its way!

It took some doing!

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This fan's operation was vital to both the customer and the insurance company whose business interruption policy was in effect. Prompt replacement of the wheel was imperative.

Here, too, it took some doing!

The original hub was returned to Clarage by air at 10 a.m. on Tuesday. Manufacture of the rest of the wheel had already begun. Thirty hours later—at 4 p.m. on Wednesday—a new 1300 pound precision built wheel and 400 pound inlet cone were being loaded at the Clarage plant for delivery to the airport.

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Result: another customer (plus an insurance company) impressed by Clarage's all-out service.

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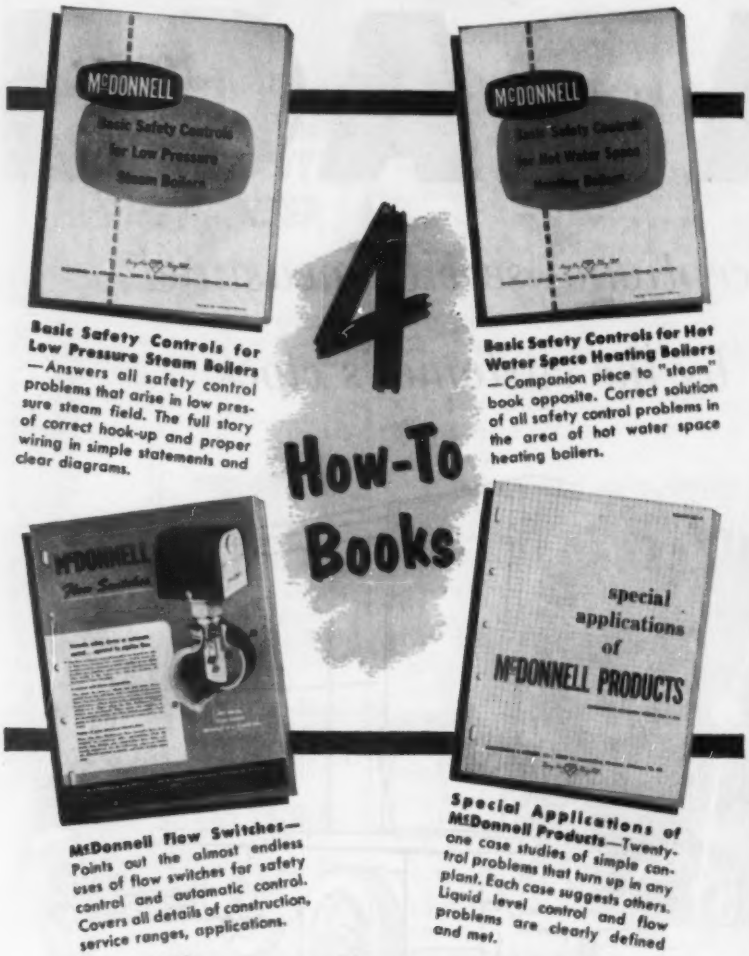

Basic Safety Controls for Low Pressure Steam Boilers—Answers all safety control problems that arise in low pressure steam field. The full story of correct hook-up and proper wiring in simple statements and clear diagrams.

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—for every engineer

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Marmaduke

Begins on page 152

there nearest the galley stopped twice yesterday, a couple of times the day before and about four times last week. Gladys misbehaved only once.'

"Figuring what was coming upwind, I cut in. 'How about showing me to the motor room, Tim,' I asked. As he steered me there, I heard the manager pipe up something about a lot of junk being sold for elevators. Boy, was he working up a storm.

"In the motor room I saw that the slack-cable switch under the drum was the type that would break when a slight pressure was applied on the apron. I also noticed that this apron extended thwartships across the entire width of the drum. Looking a little closer, I got a clue that started the wheels buzzing 'round and 'round in my noggin.

" 'OK,' I said to Tim, 'let's shove off for that bar again. I need a gullet washer to burn up the fog in my cranium.'

" 'Roger,' he agreed, turning on his heel.

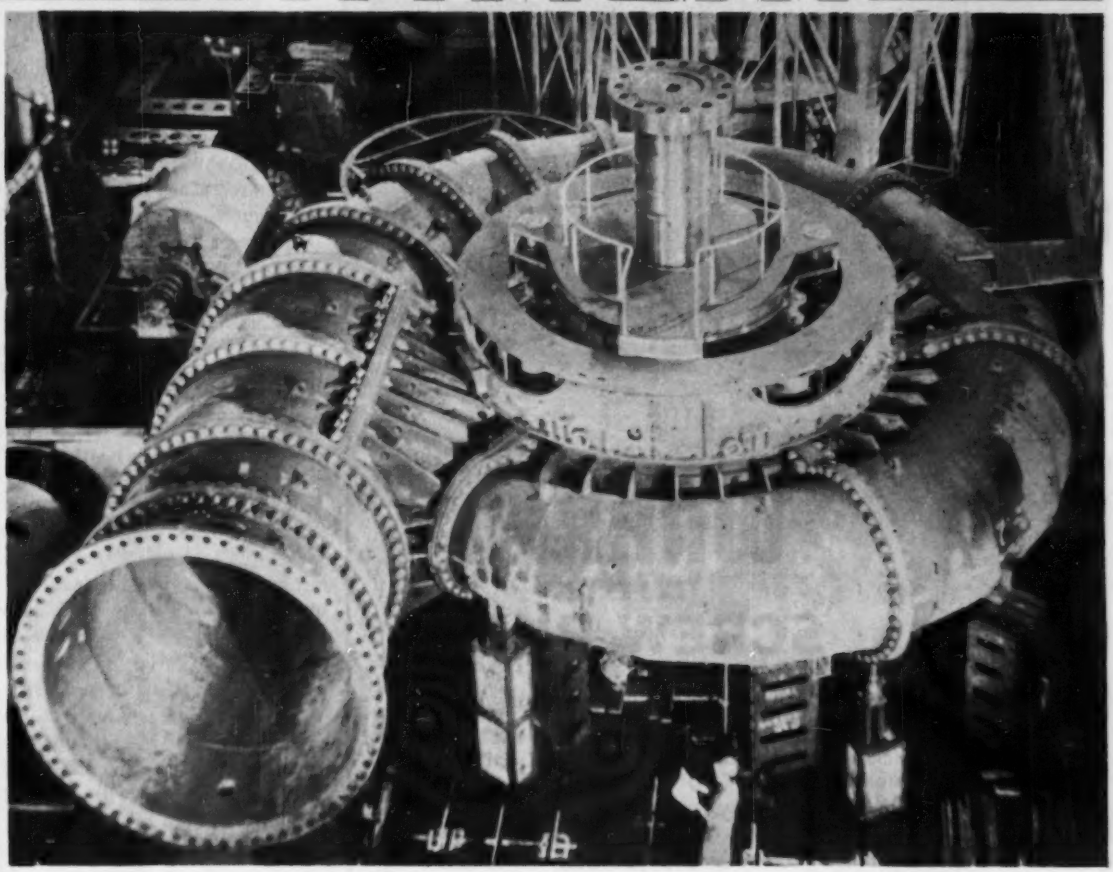
"Barging into the grog shop, we navigated head-on into the manager and the contractor at the bar. They were both still riding high.

" 'I don't give a blown fuse how those cars act,' yelled the contractor. 'We've checked everything from hell to breakfast — everything's in first-class condition. And those cars work like a charm every damn time we scoot down to the motor room. How in hell is it they only balk when we're not here? How do I know you're not giving us that old line to hold up payments? Hell, your service contract ran out three months ago. I've already lost money on this deal —even if you pay in full tomorrow.'

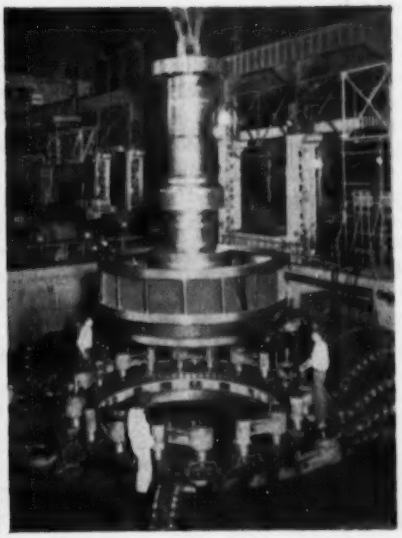
" 'Just a minute, Gerber—hold it,' came back the manager hot and loud. 'I don't like the insinuation that I'm a liar.' With that he put down his glass and doubled his fists, then squared off.

" 'As you were, boys,' I yelled, barging between them. 'Let's drop anchor here with Tim Gilhooley like civilized people and have a drink. Scrapping won't fix those cantanker-

HITACHI



Another big Francis Turbine by Hitachi



The completion of yet another big Hitachi job was recently marked by the successful factory tests of a 137,500 kw Francis Turbine. This is the first of a pair to be built, together with two 125,000 kva generators for the Miboro Power Station in Central Japan.

This vertical-shaft Francis turbine is specified for a speed of 225rpm, a maximum effective head of 200m and 76.6m^3/sec water flow, making it one of the largest units of its kind in the world. Its runner has a maximum diameter of 3.7m and the main shaft a diameter of 95cm. The spiral casing, which was constructed in 13 sections to facilitate transportation to the site, has an inlet diameter of 3.35m and an outer diameter of 11.2m.

Hitachi, Ltd.
Tokyo Japan

Cable Address: "HITACHY" TOKYO

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TYPE CB
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Specifications for High Pressure Fuel Oil Service:

Body—Heavy walls for high pressures. Two intersecting body bores ground parallel to close tolerances along entire length. Suction and discharge flanges standard ASA.

Center Bearings—Two fixed double-row, heavy duty, roller bearings at middle of span ***control possible shaft deflection at high pressures.*** Bearing housing bores ground with body bores insure concentricity. All bearing parts are ground to close tolerances for low operating clearances.

Pumping Screws—Two opposing pairs of intermeshing screws maintain pump in axial hydraulic balance ***regardless of discharge pressure.*** A specially generated straightline profile between screws results in minimum slip. Screws are machined for close tolerance between body and screws, and between intersecting screws.

Timing Gears—***Have increased face width for high pressure service.*** Proper positioning at factory prevents metallic contact between screws, eliminating vibration and noise while transmitting power smoothly.

Inboard and Outboard Bearings—Standard, and selected for maximum life based on pump's maximum operating conditions. Each timing gear is supported by a pair of double-row, heavy duty roller bearings to isolate radial loads from screws.

Shafts—Designed for both high speed and high torque applications.

Stuffing Box—Under suction pressure only. Valve control can be provided for pressure lubrication and sealing.

Mounting—The pump is adaptable for horizontal, vertical or inclined installation.

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Marmaduke

Begins on page 152

ous elevators.' That crack lowered their temperature a few degrees, but those guys were both at 212 F as they stared at me suspiciously. While the waiter was getting our lubrication I started pitching curves at Tim, just to change the subject. With the embalming fluid on the table, I lifted my glass and offered a toast.

" 'Here's to the end of your elevator troubles,' I said, and started to bend my elbow. 'Before I drink to that,' piped up the building manager, simmering again, 'I want Gerber here to tell me how he's gonna do that neat little trick.'

" 'Look here, Sullivan,' shot back Gerber, 'I told you I've spent all my profits on your building and I'm living on my kid's piggy bank. Everything checks 100% when we show up. It could even be the subway under this building or something. I don't know. What in hell you expect me to do, install a continuous monitoring system or something just to see what's wrong with your 2-bit building?'

"Just then the bar's tomcat jumped up on my lap. I offered him a piece of cheese from the table, but he only rubbed his head against my vest.

" 'Now hear this,' I barked, banging my fist on the table while trying to be as diplomatic as possible, 'if you two chowder heads'll try using the brains of a medium-sized clam, you'll agree to just that.'

"That put their engines astern, but fast. They both glared at me as if they were in a pea-soup fog. Even Tim started to fidget, getting pink around the gills. His looks told me he was sorry for taking me in tow, and that he thought maybe I had stripped my gears for good measure.

" 'Just what do you mean by that crack?' shot back Gerber, chomping into his stogie.

" 'This,' I barked, looking him straight between the eyes, 'your solution *is* a continuous monitoring system.'

"The three of them focused on me again. 'Are you kidding?' Gerber finally yelled so loud that the cash

"STOP! they forgot their P.F.I. STANDARDS!"

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While we're afraid the P.F.I. Standards wouldn't be much use to the moon travelers above, they *are* valuable to you "earth-grounded" readers.

Listed at the left are the technical bulletins that are proving their usefulness to many engineers.

These P.F.I. Standards are packed with vital data on the design, the fabrication and erection of high pressure and high temperature piping used by all industry. However, these technical bulletins do not explain the many advantages of shop fabrication.

Remember, shop fabrication by the companies responsible for the development of P.F.I. Standards is your only real assurance of meeting the most exacting requirements of piping, whether it's welded, bent, coiled or vanstoned . . . in any metal as a component or a complete assembly. Write for all ten P.F.I. Standards or indicate in the coupon below which ones could be helpful to you.

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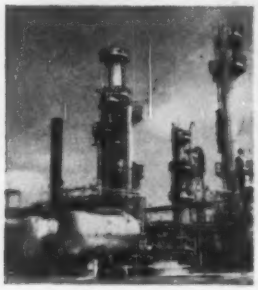
SARCO TOPICS

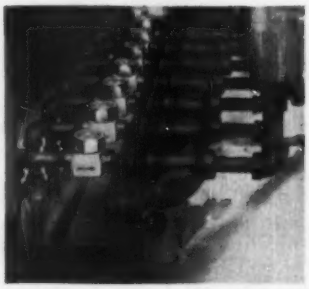
HOW TO SOLVE COMMON TRACER LINE PROBLEMS

How to cure water hammer with a steam trap that will operate in vertical position



Water hammer is an inherent problem in long tracer lines. So is freezing. Both problems can be overcome, and here's an example of how it has been done. At the Socony Mobil Oil Company's Paulsboro, N. J., refinery, they found that the Sarco Thermo-Dynamic Steam Trap, type TD-50, not only withstands water hammer, but installing the trap in a vertical position —which permits free drainage—presents no problems at all, thanks to its unique thermodynamic principle. In fact, 90% of the 250 TD-50's at this plant are vertically mounted. They never block heat transfer, and they remove condensate and air as fast as they collect.

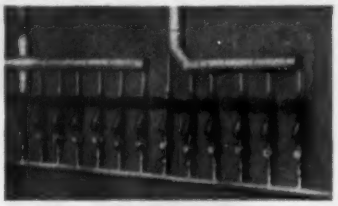
How to handle varied steam pressures — without adjustment



Can a trap — without adjustment — handle steam pressures that vary from 15 to 160 psi? Can the *same* trap vent air and drain condensate as rapidly as it is formed, be easy to install and require practically no maintenance at all? That was the problem set up by the engineering staff of Armour Chemical Division's McCook plant. They solved it by testing many traps. Their conclusion: Sarco TD-50 steam traps meet or beat their specifications, because:
they discharged condensate as fast as it formed, without wasting steam;
their compact inline construction made installation easy, even in tight quarters;
maintenance was practically negligible;
no adjustment was necessary for varying steam pressures. (In fact, the TD-50 is self-adjusting through its full operating range of 10-600 psi.)

No other steam trap can so adequately solve all these problems at one time.

How to be certain process fluid stays above 280° F. in tracer lines when outside temperature drops to 10° F.



The problem of maintaining design temperatures on tracer lines need not be difficult, no matter how extreme the conditions seem to be. For example, the tracer lines in a phthalic anhydride process at Witco Chemical Company's new Chicago plant had to be maintained above 280° F. Below this temperature, the chemical sets and the whole system would have to be taken apart and re-assembled. That's not all; ambient temperatures sometimes could drop to −10° F.

With reliability as a prime consideration, Scientific Design Company, Inc., who designed and constructed this brand new plant, selected the TD-50.

Because the TD-50 can be mounted vertically, freezing was no problem either. Added benefits that matter on tracer lines: the TD-50 is compact, light in weight, easy to install.

What is the most reliable tracer line trapping method to prevent unscheduled shutdown?

Particularly in refineries, steam traps have to function under exactly the kind of conditions that you'd expect to cause failure—they must function equally satisfactorily on low pressure or exhaust steam and on up through high-pressure, high temperature ranges. Not only that, but outside temperature may vary from subzero to subtropical. If maintaining design temperatures in your tracer lines appears to be hampered by these problems, consider how Phillips Petroleum Company, Kansas City, solved them. They found a trap which drains their tracer lines automatically over a full range of pressure, temperatures and loads. It's the Sarco TD-50 Steam Trap.

With only one moving part—a stainless steel disc, the TD-50 has little that can go wrong. In fact, it's so free of trouble that Phillips Petroleum Company consider their TD-50's as reliable and efficient as the piping. They now rely on 1800 of them throughout the plant. 1408

FOR FULL INFORMATION ON TRACER LINE TRAPPING or on any steam trapping problem—see your Sarco Sales Representative or write to

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635 Madison Avenue,
New York 22, N. Y.
Plant: Bethlehem, Pa.

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Maintenance Time: 40 Seconds. If it now takes your maintenance crew more than a couple of minutes to service an ordinary trap, you're throwing away valuable time. This Sarco Thermo-Dynamic can be cleaned, blown out if necessary, and reassembled on the line in as little as 40 seconds.

For Prompt Information on the TD-50 . . . or for fast help on the efficient solution of any steam trapping problems, get in touch with a SARCO District Office, Sales Representative, or Distributor. (There's one near you.)

Only SARCO makes all 5 types:
Thermo-Dynamic* • Thermostatic • Liquid Expansion • Float Thermostatic • Inverted Bucket

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circle 302 on Reader Service card, p 117

Marmaduke

Begins on page 152

customers gathered around us like a ground swell. 'What'll I do, get a flock of laboratory instruments and a group of scientists from MIT or some research foundation to do the monitoring?'

" 'No,' I answered calmly, 'here's your continuous monitoring system,' and with that I threw the cat into his lap.

"That did it. Everybody busted out guffawing, minus three. Those three were turning a lobster red, especially Gerber. He was raising a full head of steam again, and I could see that his safety valve would pop any minute.

" 'Here's why,' I explained quietly, lighting my cigar. 'The elevator nearest the galley gives the most trouble. Why? Because there's food around. And where there's food there are usually rodents. I saw droppings around the slack-cable apron on the freshly painted bed plate. Rodents sitting on the slack-cable apron break the circuit of the slack-cable switch. Not enough to throw the lever to make it nonreseatable, but just enough to open the circuit and interrupt service.

" 'So Tim or your troubleshooter has to slog down to the motor room. What happens? He scares the animals away. That allows the circuit to close, and the elevator answers the last call stored in its memory system. Then everything is shipshape again.'

"For a second no one breathed. Then Gerber suddenly jumped up on his chair and yelled, 'YIPPEEE, I think this guy's right! Ha ha ha, the cat here, a continuous monitoring system, that's rich, ha ha ha ha ha, a continuous mon. . . .' "

—STEVE ELONKA

Marmy's mailbox

I must admit that Marmy's stories are not only interesting, but also factual and most practical. Pleasure

Measure your results with this SPEED "YARDSTICK"

Speed is one of your most valuable "yardsticks" in the measurement of

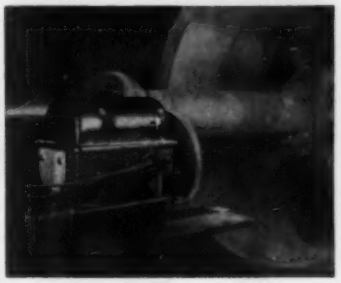
- ★ **rate of production,**
- ★ **quality of product,**
- ★ **performance of machinery and equipment.**

The simplest, most accurate way to measure and record speed is the electrical method—with an Esterline-Angus Speed Recorder System.

For example, you can determine processing time with a record of conveyor speed through an annealing lehr, a plating bath or a bakery oven.

You can chart operating conditions, lost time and performance of important equipment such as steel rolling mills and machines for making paper, wall board, roofing, felt, textiles, etc.

Steam turbines, pumps, blowers, presses and marine engines are others among a multitude of machines where a record of speed is important.



In the Esterline-Angus Speed Recorder System, an E/A Tachometer Generator (pictured here), actuates an E/A strip-chart Speed Recorder (above) to give you an indisputable record, free of human bias and error.

Like all Esterline-Angus graphic instruments and accessory equipment, the Tachometer Generator and the Speed Recorder are ruggedly built for accuracy and dependability over a long and useful life.

Send for Catalog Section 46 and see how the E/A Speed Recorder System can help you.

The Esterline-Angus Company

No. 1 in fine Graphic Instruments for more than 50 years.

DEPT. N, P.O. BOX 596, INDIANAPOLIS 6, INDIANA

circle 303 on Reader Service card, p 117

SAVE TIME
WITH KAMLOK QUICK COUPLERS

CUT YOUR MAINTENANCE COSTS

Save production time by replacing hose and pipe connections with Kamlok Quick Couplers. Used wherever hose and pipe connections are periodically uncoupled. Fast . . . Safe . . . Sure. No tools needed. Just fit together and pull the cam arms down. Lock securely in place. Leakproof gasket cannot fall out. All Kamloks 100% master gauged for complete interchangeability.

KAMLOKS are available from stock in bronze, aluminum, stainless steel, monel and semi-steel from ½" through 6" sizes. 39 different styles to choose from. Specials to fit your needs. Get full details.

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KAM 2

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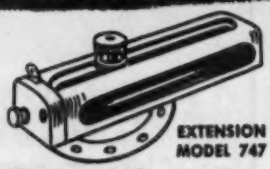
circle 304 on Reader Service card, p 117

"ON-THE SPOT" EFFICIENCY

SPEARHEAD GASKET CUTTERS

HAND • TOOLS



EXTENSION MODEL 747

Aluminum body with steel blades and inch and metric scales. Cuts precision round gaskets any size

HANDY MODEL 750

Phenolic body with steel blades and inch and metric scales . . . cuts round gaskets ¼" to 6", odd shapes and straight pieces any size

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DEPENDABLE GENERATOR OPERATION

Spark Free!
EXPLOSION RESISTANT

Adaptable To Any Industrial Engine!

Kato's complete line of 50, 60 and 400 cycle revolving field AC Generators is now available in brushless design.

Especially desirable for operation in gaseous environments.

GREATLY REDUCED MAINTENANCE!

KATO BRUSHLESS AC GENERATORS

60 CYCLE SIZES
3 Phase: 5 to 400 KW
1 Phase: 5 to 150 KW

SPEEDS
720, 900, 1200, 1800 RPM.

Take your choice throughout the Kato Line—Brushless or standard slip ring types. For all your 400 cycle or power converting needs investigate Kato's complete line of high frequency alternators and motor generator sets. Complete control systems for all Kato products include Kato magnetic amplifiers, voltage regulators, static exciters and motor starters for synchronous or induction motors.

Builders of Fine Rotating Electrical Machinery Since 1928!

NEW BRUSHLESS GENERATOR CATALOG
Write For It Today!

KATO ENGINEERING COMPANY

1479 FIRST AVE., MANKATO, MINN.
PHONE 8-2941

Marmaduke

Begins on page 152

to read them. But in *Marmy tickles her ribs*, August 1958 issue, how much vacuum did he have? He said he drained the condensate from the condenser while under vacuum into the sewer line in the basement. Did he do this by increasing the capacity of the condensate pump to remove the discharge head?

H CARNES, *Newburgh, N.Y.*

EDITOR'S NOTE: *Marmy opened the bleed valve on the pump's discharge. That removed the hot well water. Of course this water was wasted to the sewer, but what the hell. He had to keep the plant running.*

REMINDS OF FRIEND

Some of Marmy's adventures remind me of the experiences of my late friend John Weist. He was a machinist before the Civil War, volunteered in the Yankee Cavalry, became steamboat engineer and later was chief engineer of the Louisville Water Co pumping station. While steamboating he was chief on the *Robert E Lee* and caulked a leaky flue under full pressure while racing the *Natchez*.

F S CARPENTER, *Louisville, Ky.*

A GREAT GUY

I work for a mill-supply distributor, and in our office I always look for the latest Marmy story. I've handled enough invoices on tube cleaners, grinding wheels, pumps and other equipment used around power plants to know what the old consultant is talking about. But the fact is, I've learned more about power plants from Marmy's stories than I have from our business. I think he is a wonderful man, and I do mean *man*.

MARJORIE ROKOFF, *New York City*

MARMY POPULAR

For years I've had the pleasure of reading the amazing experiences of that world-renowned engineer, Marmaduke. He is very popular in our plant. I look forward to keeping up with him for years to come.

K P VAN HUBEN, *Orangeburg, N.Y.*

GET THAT BETTER PUMP FOR YOUR NEW BUILDING

PEERLESS PUMPS

Why the Aqua Line for your job?

Fast, Easy Installation—Peerless AquaLine pumps install quickly in new or existing systems. No special tools are required. Take it out of the package and put it to work.

Compact, Space Saving — Sealed type AquaLines require only one-half the space of other type pumps. Even the packed types are streamline and compact, permitting efficient space-saving layouts.

Easy to Maintain—AquaLine's horizontal split-case design affords quick inspection of rotating parts without disturbing piping. Parts lift out for easy replacement, materially reducing down time.

Immediate Availability—All sizes of pumps and parts are stocked for rapid delivery. You get the pump you want when you need it—ready to unpack and install.

Low in Cost, High in Quality—Peerless AquaLine pumps are engineered with the same high-quality traditionally found only in more expensive units. Yet this pump is priced right. Get the facts. Send for Bulletin B-2100 today.

FOR EFFICIENT DEPENDABLE WATER HANDLING SPECIFY THE NEW PEERLESS *Aqua Line* PUMP

AquaLine Characteristics:

Sizes: to 8 inches — **Capacities: to 2600 gpm**

Heads: to 280 feet — **Temperatures: to 250° F**

ATTENTION DEALERS: A few choice dealerships are available for the Peerless AquaLine Pump. Write us for more details.

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New York; Detroit; Cleveland; Chicago; Indianapolis; St. Louis; San Francisco; Atlanta; Plainview; Lubbock; Phoenix; Albuquerque; Los Angeles; Fresno.
Distributors in principal cities.
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For more facts circle 307 on Reader Service card, p 117

The contributions C. H. Wheeler's Reverse Flow makes in solving CONDENSER MAINTENANCE PROBLEMS

An informative advertisement from one of the nation's most experienced condenser manufacturers

Since a major condenser maintenance problem is caused by foreign matter, algae and scale which clog tubes and sheets, there is a constant search for better ways to remove this contamination. One of the most successful methods is Reverse Flow (see diagram on right), a system of back-flushing tubes and sheets without shutting down the condenser.

This Reverse Flow design, patented by C. H. Wheeler Manufacturing Company, designer and builder of steam condensers since 1903, has proved itself in installations throughout the world. Here's how it works:

Normal operation is shown on the left. Water enters through inlet A with inside port open, flows through tube bank C to the rear of the condenser. It returns through tube bank D to the front of the condenser and discharges at E.

The right side of the diagram above shows Reverse Flow in operation in a C. H. Wheeler Dual Bank, Divided Water Box Condenser. Water enters through A with outside port open, flows up through channel B and through tube bank D to rear of condenser, returns through tube bank C to front of condenser and discharges at E. Reversing can be accomplished during full load operation and full flow of circulating water, without additional pressure loss. Sluice gates for each half of the condenser move on a common stem. Each half of the condenser can be back-flushed independently; or both halves can be back-flushed simultaneously with one or two circulating pumps operating.

Other Ways To Keep Tubes Clean

Special slugs are sometimes used to remove algae and foreign matter from the insides of condenser tubes. They're forced through the tubes by high-pressure water; thus scale and other contamination is flushed as it's dislodged. When the slugs are metal, care must be taken to prevent ruining them as they fly from the outlet side of the tubes.

Sometimes a 5% HCl solution is introduced into the tubes to dissolve the scale. While this method is effective, it is often necessary to leave the acid in the tubes for six hours or so—thus prolonging down time. Also, it's necessary to flush the tubes before the condenser can be put back in service.

In general, maintenance becomes more of a problem as water-source pollution increases; also as circulating water temperature rises, because the rate of scale formation increases at higher water temperatures.

Solving Deaeration Problems

Oxygen and other non-condensable vapors in the condensate result from leaks or are introduced through make-up water or heater returns. Most authorities believe that the greatest source of oxygen is make-up water.

Make-up water which is not properly heated in the condenser and agitated sufficiently to release entrained gases results in excessive oxygen and other non-condensables in the condensate. As a consequence, corrosive oxides may be deposited in the boiler, reducing its efficiency.

Proper distribution of normal make-up water is achieved in Wheeler condensers by spraying it over the top of the tube banks at both ends of the tubes, and out of the path of high-velocity steam from the turbine exhaust. Steel bars above tubes protect them from water impingement damage.

Heater returns are sprayed in the steam lanes to permit flashing and distribution of the returns and release of entrained gases.

All condensate draining off the tubes is cascaded over a series of horizontal deaerating bars (1, Fig. 3) in the presence of a moving blanket of steam to provide greater agitation and reheating before condensate is drained into the hotwell.

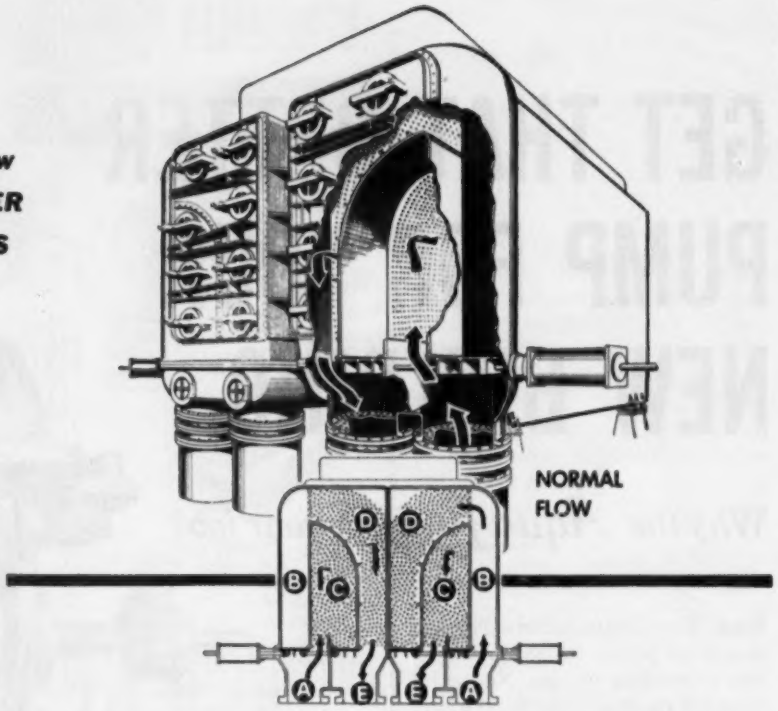

Fig. 1: Simplified diagram showing how Reverse Flow cleans tubes and sheets during full load operation.

Fig. 2: A few of the types of slugs used to clean the inside of condenser tubes.

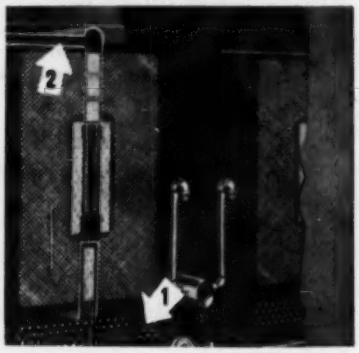

Fig. 3: Drawing of deaerating bars and air-vapor suction line. Tubejet® Air Ejector.

Notice too, location of the air-vapor suction line (2), through which the Tubejet® Ejector draws off non-condensable gases and discharges them to the atmosphere.

In C. H. Wheeler Dual Bank Divided Water Box Condensers the air cooler section is centrally located, so as to reduce depth of steam penetration and consequently resistance to steam passage, achieving a new low in pressure loss in the condenser.

If you have a maintenance problem that doesn't seem to improve no matter what you do, C. H. Wheeler may be able to help. Get in touch with a Wheeler representative or write direct. No obligation.

C. H. WHEELER MFG. CO.

19th and Lehigh Avenue • Philadelphia 32, Pennsylvania

Whenever you see the name C.H. Wheeler on a product, you know it's a quality product.

Steam Condensers • Steam Jet Vacuum Equipment • Centrifugal, Axial and Mixed Flow Pumps • Marine Auxiliary Machinery • Nuclear Components

K&M ZEBRA

THE YEARS-AHEAD DEVELOPMENT IN PIPE INSULATION!

3 times faster to apply than 2-layer sectional insulation, new "K&M" ZEBRA is a low, medium and high-temperature multi-layer sectional-type thermal insulation. It's as rugged as it is speedy. Its deflection at breaking point is 2 to 4 times that of ordinary insulation. That's why breakage during installation practically disappears. There's a new ease of handling, too. No skin irritation. No skin penetration by ragged projections. "K&M" ZEBRA is smooth-surfaced. And, too, it's easy to cut and fabricate . . . practically dust free. Get more information on this exciting, new development in pipe insulation. Write to us today for more information.

• For temperatures of 200°F. to 1200°F. • Withstands shock and heat without warping or cracking. • Made of calcium silicate—asbestos fiber bonded felts. • Can be re-used . . . can be dismantled and re-applied. • Available in wide range of sizes and thicknesses. • Tested by an independent testing laboratory.

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KEASBEY & MATTISON
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For more facts circle 309 on Reader Service card, p 117

Powerscope . . . A selective look at

Automation saves

General Electric Co recently announced that development of transistorized digital computers compatible with existing sensing devices and automatic subsystems has made the automatic steam station an engineering reality. Applying computers for continuous precise control makes the automatic station an economic reality. A 500-mw steam station could realize capitalized savings of about $1¼ to $2¾ million through complete automation. Automating equipment costs about $1 million more than conventional control equipment. Improving reliability as little as ¼% by automation makes capitalized savings of $750,000. Precise control of operating conditions reduces maintenance and can raise capitalized savings by another $750,000. Improved fuel economy will also add to savings—a 1% increase can mean about $500,000. Labor saving of one man per shift saves about $200,000. Eliminating many recording instruments saves about another $50,000.

Floods of oil

In 1959 U.S. demand for petroleum products reached a new high of 3473 million bbl, a growth of 4% over 1958 according to American Petroleum Institute. Natural-gas liquids also reached a record high of 319 million bbl. Capital expenditure during 1959 was $5500 million, making total investment since World War II over $61 billion for the oil industry. Motor-fuel demand rose to 1482 million bbl and distillate fuel for home and industry to 684 million bbl. Well completions in 1959 are about 51,000 compared to 49,000 for 1958. Exploratory wells ran about 10,100 of which 8700 will be dry.

In anniversary of its 100th year the oil industry, through the API, envisioned wider use of its products. Snow in cities will be melted by being bulldozed into oil-burning pits. Synthetic protein from oil could feed underdeveloped areas. Seed beds on farms could be covered by an asphalt film during germination to retain moisture during the 5- or 6-week period. Asphalt will be used more and more for shingles, siding, flooring and insulation —even in upholstery for the home. Petrochemicals already play a part in plastics, drip-dry shirts and synthetic rubber. API says the world's oil will last for 500 years at present consumption rates.

American Society for Engineering Education has issued a revised code: "Recruiting practices and procedures—1959." The 4-page leaflet, 10c from ASEE, University of Illinois, Urbana, Ill. outlines responsibilities of employers, college and student. Code aims to: (1) promote a wise and responsible choice of career (2) strengthen students' sense of integrity (3) develop in students an attitude of personal responsibility (4) minimize interference with education.

Working water

Next station scheduled for Union Electric Company (Missouri) is a pumped-storage plant with a capacity of 350 mw, scheduled to start in spring of 1963, number of units in plant not announced. The Taum Sauk Plant will cost about $50 million including transmission lines and will be near Lesterville, Mo. An upper pool, on a granite knob, will be about 1000 ft above the lower pool in Taum Sauk Creek and the east fork of the Black River impounded by a dam. The 50-acre upper pool connects to the lower 370-acre pool through a mile-long 26-ft-dia water tunnel bored through granite. Overall efficiency of plant using reversible pump-turbines will be about 65%. Project will use 1000 construction workers.

In December 1959 the American Electric Power System had a new all-time peak load of 4730 mw. This was an increase of 9.2% over its 1958 peak and is the highest load ever carried by any private electric-utility system.

The British Central Electricity Generating Board has installed the first 3-mw remotely controlled gas turbine-generators for peaking service. The set in Princetown, Devon is controlled from Bristol, 100 miles away, over the public telephone system. The gas turbine is a modified version of the Proteus turbo-propeller engine which powers the Britannia airliner. Unit weighs less than 1½ tons and can be loaded from cold in about 2½ minutes. Installed cost is expected to be considerably less than that of a diesel engine.

Power for war

Titan Bases, Squadrons I and II, costing $67 million, are being built on the Lowry Air-Force Base bombing range outside Denver. Completely underground with reinforced-concrete walls 1- to 10-ft thick, the two squadrons will have six entirely self-sufficient missile-launching sites. Only a direct hit by a nuclear warhead could knock out any one of the Titans. Missiles will be stored and fired from silos 165-ft underground. Each squadron has three

this month's power-field happenings

B G A SKROTZKI, Associate Editor

launching pads with underground chambers for equipment and personnel. Each pad will have its own powerhouse with four diesel engines driving 1-mw generators and two 300-ton air-conditioning units. Worthington Corp will supply 24 diesel engine-generators, 12 chillers and 18 compressors together with auxiliary pumps and other equipment for the installation.

Men wanted

American business firms employed about 780,000 engineers and scientists in January 1959 according to the National Science Foundation. About 35% worked in research and development activities. Engineers and scientists in industry are about two-thirds of the total working in the U.S.A. The other third work in government agencies, schools, nonprofit organizations and for themselves. Aircraft, electric-equipment and chemical industries each employed more than 75,000. Engineers employed rose from 605,000 in January 1958 to 630,000 in January 1959.

Construction contracts for the $350-million John Day Dam on the Snake River have been signed. Work under supervision of the U.S. Army Corps of Engineers will start immediately. Target date of August 30, 1962 makes this one of the fastest schedules ever set. Ultimate plant capacity is 2757 mw.— ***M-H Pacific Coast News Bureau.***

Factory shipments of electrical-manufacturing-industry products totaled $21.5 billion in 1959, an increase of 11% over 1958. NEMA predicts that 1960 shipments will be more than $23 billion. Previous high was $21.9 billion in 1956. In these totals, industrial equipment rose from $3.0 billion to $3.46 billion (1958 to 1959) while generation, transmission and distribution equipment rose from $2.05 to $2.08 billion despite heavy imports.

Daystrom Incorporated reports that electronic inventory systems find greater use in transportation - reservation systems, banks, business. Solid-state semiconductor devices have materially improved in performance and reliability while being drastically reduced in cost. Cost of solid-state devices still exceeds cost of vacuum tubes but an economic crossover may come this year. Process industries hesitate to adopt computer controls because of large investment, but dropping costs may change this attitude. Speeds are expected soon to reach the handling of one billion bits of data per sec.

Arizona Power Authority of Phoenix, Ariz. proposes a $347.3-million hydro project on the Colorado River in Arizona. It would have an initial capacity of 820 mw with possible future addition of 650 mw. It would have three parts—Bridge Canyon, Marble Canyon and Little Colorado River. Bridge Canyon would be a double-curvature arch dam, 1520-ft long, 480-ft high, with a reservoir of 820,000 acre-ft and four 120-mw units in an underground plant. Marble Canyon would be an arch dam 700-ft long, 400-ft high, with reservoir of 480,000 acre-ft and four 85-mw units. Little Colorado would be two reservoirs for silt detention.

Two giant balloons will be launched from an aircraft carrier in the Caribbean late in January to let scientists record very-high-energy cosmic rays. Balloons are expected to remain aloft for 48 hr at altitudes of 18 to 22 miles. Each balloon will lift 2500-lb loads including 800-lb blocks consisting of sheets of pure emulsion similar to photographic film. Emulsions will record primary cosmic rays or nuclear particles with energies as high as 10,000-billion electron volts. Blocks will trace the paths in three dimensions. The emulsion was made in England and will be processed in Chicago. About two years will be needed by cosmic ray groups in the U.S. and abroad to analyze the data.

Revived tidal plan

Electricité de France in 1957 abandoned its plan to generate power from Rance estuary 34-ft tides because of lack of funds. Project has now been scaled down from 40 to 24 generating units in a dike somewhat shorter than the original 2400 ft. Revised project, now estimated to cost $80 million, is expected to produce power at a cost competitive with conventional plants.

Harvard University has launched a new program to apply modern physics in the study of the earth's atmosphere. Grants of nearly $300,000 from three foundations will support the program. Studies will cover electrical and optical properties of the atmosphere, circulation of large bodies of air, formation of vortices and turbulence, behavior of atmospheric vapor, spectroscopic analysis of the air at many wave lengths. Meteorologists usually concentrate on outstanding features such as classifying clouds and collecting barometer readings, rather than deriving properties of the atmosphere. Past atmospheric science concentrated on weather forecasting rather than on the basic origin of atmospheric phenomena in its wide variety of forms.

REMOVE OXYGEN

FROM BOILER WATER...

DEOXY-SOL

Fairmount DEOXY-SOL, a solution of hydrazine, is a high efficiency oxygen scavenger designed especially for high pressure boiler water treatment.

DEOXY-SOL removes oxygen, reduces oxides and raises pH of the condensate all at the same time . . . yet adds no solids.

Stocks in Newark, N. J., Chicago, Ill., Los Angeles, Calif. Investigate its advantages for your system. Write for Bulletin BW.

Fairmount
CHEMICAL CO., INC.
136 Liberty St. New York 6, N. Y.

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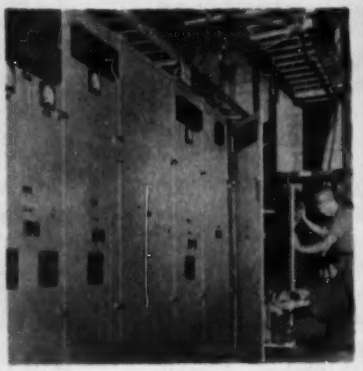
Reports
from the field



Frames of h-v switchgear go to Philadelphia plant

A huge new generating station, Philadelphia Electric Company's 650-mw Eddystone plant, received 102 frames of high-voltage switch-gear from I-T-E Circuit Breaker Company. Installation incorporates 4160-v air-magnetic circuit breakers. Control and protection of entire station's auxiliary power system is expected.

The three main breakers, protecting 4160-v starting buses, are rated 3000 amp with interrupting ratings of 350 mva. All other breakers are 1200- and 2000-amp units with 250-mva interrupting ratings. Power requirements during startups of the auxiliaries for one generating unit are in excess of 2000 amp. Two 325-mw generating units will go into commercial operation early this year.

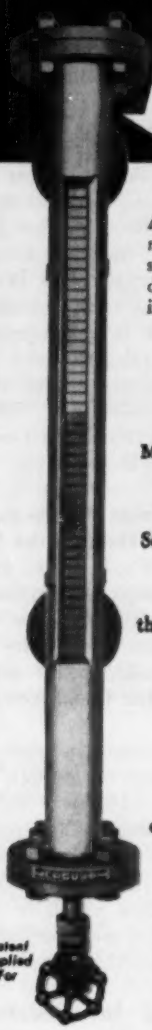
ISA translation program forges ahead

Instrument Society of America has received a grant from the National Science Foundation to continue translation and publication of English editions of four leading Russian technical journals. "Soviet Instrumentation and Control Translation Series", now

the New Jerguson

MAGNETIC GAGE

for liquid levels



Patent Applied For

An important advancement in liquid level observation for plants with dangerous explosive or inflammable conditions.

Safety design seals against escaping gases.

Measuring mechanism in stainless steel chamber.

Scale mounted outside chamber; magnetically actuated through chamber wall.

Distinct, accurate level shown in red contrasted with silver above.

Job designed, correlating pressure, temperature, and specific gravity.

Available with electric alarms.

Can also be used for interface indication.

Write now for engineering sheet on Jerguson Magnetic Gages.

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Gages and Valves for the Observation of Liquids and Levels

JERGUSON GAGE & VALVE COMPANY
100 Adams Street, Burlington, Mass.
Offices in Major Cities
In Canada: Peacock Bros. Ltd.

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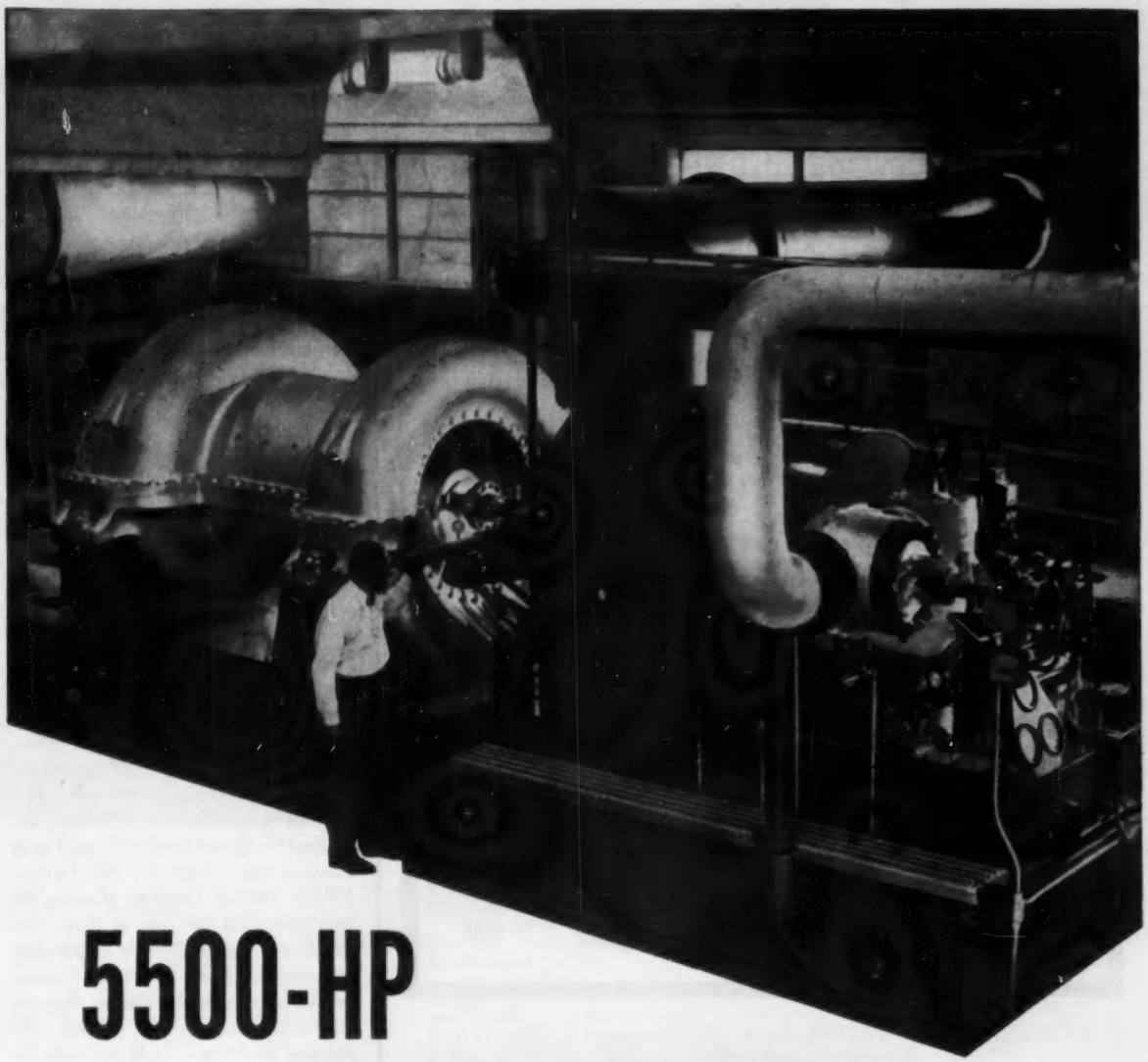


5500-HP TERRY TURBINE

plays an important role in compressor testing at Joy

Joy Manufacturing Company puts Terry high-speed turbine reliability to good use in its development facility at Buffalo, New York. This 5500-hp multistage turbine is used for testing centrifugal and axial-flow compressors. It provides speeds up to 9,000 rpm.

The long, trouble-free life of Terry high-speed turbines stems from two sources: (1) more than 50 years of successful experience in making turbine drives *exclusively*, (2) a willingness to build *something extra* into each machine to assure its reliability.

There's a reliable Terry turbine for you in sizes up to 6000 hp. In special cases higher outputs can be supplied.

For more information about Terry multistage turbines, ask for a copy of bulletin S-146.

TERRY

THE TERRY STEAM TURBINE COMPANY
TERRY SQUARE, HARTFORD 1, CONN.

TT-1215

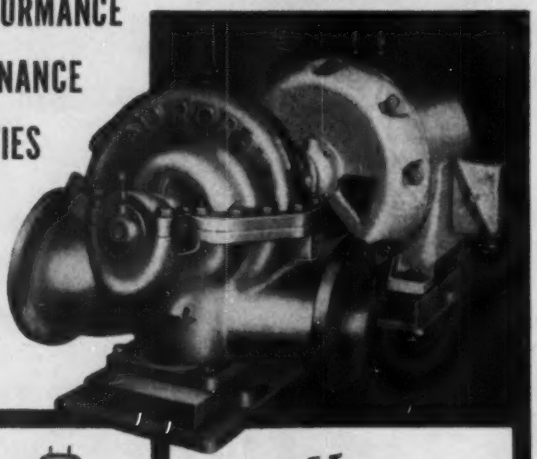
For more facts circle 312 on Reader Service card, p 117

AURORA Split Case

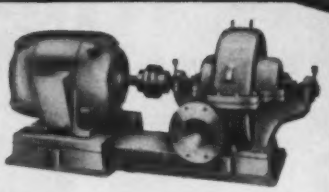
CENTRIFUGAL PUMPS

with

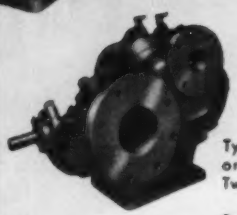
- SMOOTH PERFORMANCE
- EASY MAINTENANCE
- HIGH CAPACITIES



Type OJ Horizontally Split Single Stage Double Suction. Bulletin 105-B.



Type AJ Horizontally Split Two Stage Opposed Suction. Bulletin 106-B.



Type AJ Diagonally Split Two Stage

Bulletin 106-DS

- Capacities to 6000 GPM—heads to 600 feet—continuous operation.
- Both suction and discharge on bottom half of case . . . piping or motor-pump alignment never disturbed . . . lugs on top half of case for easy removal . . . by-pass in lantern ring exposed in lower half of case . . . fast, easy to inspect, clean and maintain . . . lines are back in operation fast!
- Streamlined liquid flow . . . hydraulically and dynamically balanced impellers . . . perfect alignment with in-line boring with top half of case in position . . . large standardized shaft sizes for maximum strength . . . short bearing centers for maximum rigidity and balance . . . low NPSH . . . smooth, long-term top performance . . . long life!

IDEAL FOR: Water Service • Boiler Feed • Circulating • Cooling Tower • Pressure Build-Up • Fuel Transfer • Boosting to Pressure or Elevated Tanks • Many General Applications.

FOR COMPLETE INFORMATION WRITE—OR CALL

AURORA Always PUMPS

AURORA PUMP DIVISION

THE NEW YORK AIR BRAKE COMPANY

1000 LOUCKS • AURORA, ILLINOIS

LOCAL DISTRIBUTOR IS LISTED IN THE YELLOW PAGES OF YOUR PHONE BOOK

Reports from the field

Begins on page 170

in its third year, offers an opportunity for U.S. scientists and engineers to become better informed on latest developments in Soviet instrumentation.

The four translated publications are important Soviet journals: *Measurement Techniques, Automation and Remote Control, Intsruments and Experimental Techniques* and *Industrial Laboratory.*

Packaged diesel peaking units power a Maine sub

Three diesel engine-generator units, each packaged to permit movement from one location to another, went into service recently at a Maine Public Service Co substation located near Presque Isle. Built by the Electro-Motive Div of General Motors, the units went on the line at their total rated capacity of 4200 kw in less than 90 seconds after C Hazen Stetson, president of Maine Public Service, telephoned company's central dispatcher in Presque Isle to push remote control buttons, automatically starting the separately housed units.

"Addition of this type of plant to our system," said Stetson, "not only provides quick peaking and reserve capacity, but results in a considerable saving in initial investment over the conventional equipment used for this type of service.

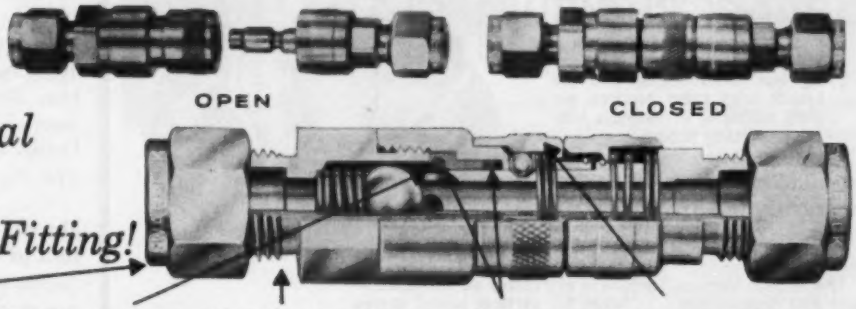
"Maine Public Service load pattern is typical of the average utility in which approximately 20% of the total load on peak is only required about 2% of the time."

Richard L Terrel, vice-president of GM and general manager of their Electro-Motive division, added, "these peaks pose more formidable economic hurdles today for utility management because they are intensely magnified by the tremendous growth pattern that has been developed in the post-war years and which extends at an

What's the secret of this fast, positive-seal fitting?

Swagelok Quick-Connect Fitting Installation in Boeing Airplane Company, Seattle, Wash., Test Facilities for Boeing 707 Jet Stratoliner.

Here's the secret of this fast, positive-seal Swagelok Quick-Connect Fitting!



1. Swagelok Quick-Connects with single end or double end shut off for tube to pipe, tube to tube, bulkhead tube to tube applications are available in brass and stainless steel in sizes for ⅛" and ¼" O. D. tubing.

2. Flow resumed instantly and vacuum tight seal assured when connection is made.

3. Light, compact, streamlined design. Occupies little space. For use with portable equipment, and bulkhead or panel applications.

4. Instant-acting seals completely prevent loss of pressure when fitting is disconnected.

5. No twisting, turning or wrench action necessary. Easy straight-line finger tip pull or push action for instant connecting or disconnecting.

In the Boeing Airplane Company photo shown above, the tubes are instrumentation pressure lines running from the large jet engines on test stands to the patch board, where the lines are coupled into measuring devices.

The Boeing Airplane Company adopted this positive Swagelok Quick-Connect Fitting to simplify test installations, and substantially cut down test set-up time. Both ends of the many pressure lines are Swagelok-equipped. Previously, engineers used a screw-type fitting which required a wrench and valuable time-consuming operations to tighten and remove.

Swagelok engineers are equipped with experience, ability, and a wide range of tube fittings designed to meet your individual problems. Quick delivery of Swagelok tube fittings from local distributor stocks.

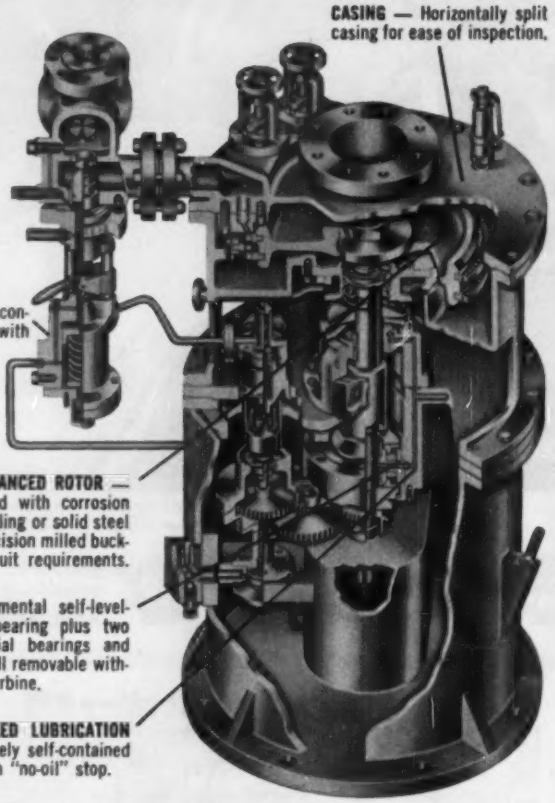
Swagelok® TUBE FITTINGS

CRAWFORD FITTING COMPANY
884 East 140th Street, Cleveland 10, Ohio
Crawford Fittings (Canada) Ltd., Niagara Falls, Ontario, Canada

For more facts circle 314 on Reader Service card, p 117

NEW Whiton VERTICAL TURBINE

Type BHBSV for Vertical Pump Drives



CASING — Horizontally split casing for ease of inspection.

SPEED CONTROL — Oil constant speed governor with overspeed stop.

DYNAMICALLY BALANCED ROTOR — Either steel forged with corrosion resistant steel blading or solid steel one piece with precision milled buckets available to suit requirements.

BEARINGS — Segmental self-leveling type thrust bearing plus two babbitt lined radial bearings and shaft packing — all removable without dismantling turbine.

FORCED FEED LUBRICATION — Completely self-contained system with "no-oil" stop.

The Whiton Vertical Turbine is extremely versatile, compact and dependable . . . ideal for vertical pump drives and other similar applications. The vertical design requires minimum installation space and allows great freedom of location. Simplicity of design and construction results in ease of operation and servicing.

With this vertical turbine added to the line, Whiton's vertical and horizontal steam turbines offer a broad range of power supply applications. Complete data on the new vertical turbine and others available on request.

MAXIMUM OPERATING SPECIFICATIONS	
POWER	to 1000 HP
SPEED	to 8500 RPM
STEAM PRESSURE	to 1250 PSIG
STEAM TEMPERATURE	to 1050 FTT

Whiton SINCE 1856

THE WHITON MACHINE COMPANY
NEW LONDON, CONNECTICUT

Reports from the field

accelerated pace far into the future."

Big feature of the units is their transportability. Easily moved, they could meet unusual area load growth, eliminating need for additional investment in transmission facilities. Units operate unattended. They're run by remote control and engineered to perform in temperatures as low as −35 F as well as in hot summer months.

Calendar of Events

Feb 21-24—American Institute of Chemical Engineers, Annual Meeting, Biltmore Hotel, Atlanta, Ga. Details: AICHE, 25 W 45th St, New York, N. Y.

March 6-9—American Society of Mechanical Engineers, Gas Turbine Power and Hydraulic Conference, Rice Hotel, Houston, Texas. Details from L S Dennegar, 29 W 39th St, New York 18, N. Y.

March 14-18—National Association of Corrosion Engineers, 16th Annual Conference and 1960 Corrosion Show, Memorial Auditorium, Dallas, Texas. Details: NACE, 1061 M&M Building, Houston 2, Texas.

March 29-31—American Society of Mechanical Engineers, American Power Conference, Sherman Hotel, Chicago, Ill. Details from L S Dennegar, 29 W 39th St, New York 18, N. Y.

March 23-26—Electric Industry Show and Lighting Exposition, sponsored by Electrical Maintenance Engineers Association of Southern California, Shrine Exposition Hall, Los Angeles. Details from F J Tabery, 3443 South Hill St, Los Angeles 7, Calif.

Begins on page 170

April 3-8—6th Nuclear Conference sponsored by Instrument Society of America, Coliseum, New York, N. Y. Details: ISA, 313 Sixth Ave, Pittsburgh 22, Pa.

April 4-7—Oil Heat Institute of America, Inc, 38th Annual Convention, Park-Shearton Hotel, New York; 23rd National Oil Heat and Air-Conditioning Exposition, Coliseum, New York. Details from OHIA, 500 Fifth Ave, New York, N. Y.

April 5-7—Instrument Society of America, 3rd National Chemical and Petroleum Instrumentation Symposium, Rochester, N. Y. Details: ISA, 313 Sixth Ave, Pittsburgh 22, Pa.

April 7-8—American Society of Mechanical Engineers and Society for Advancement of Management, Management Engineering Conference, Statler Hilton Hotel, New York. Details from L S Dennegar, 29 W 39th St, New York 18, N. Y.

April 18-19—Third Annual Conference on Automatic Techniques, sponsored by ASME, IRE, AIEE, Cleveland-Sheraton Hotel, Cleveland, Ohio. Details: J H McRainey, 1213 W Third St, Cleveland, Ohio.

April 19-21—American Society of Lubrication Engineers, Annual Meeting and Exhibition, Netherland-Hilton Hotel, Cincinnati, Ohio. Details from ASLE, 5 N Wabash Ave, Chicago 2, Ill.

April 19-21 — Microwave Research Institute of Polytechnic Institute of Brooklyn, Annual International Symposium, Engineering Societies Building, New York. Details: Professor H J Carlin, Microwave Research Institute, 55 Johnson St, Brooklyn 1, N. Y.

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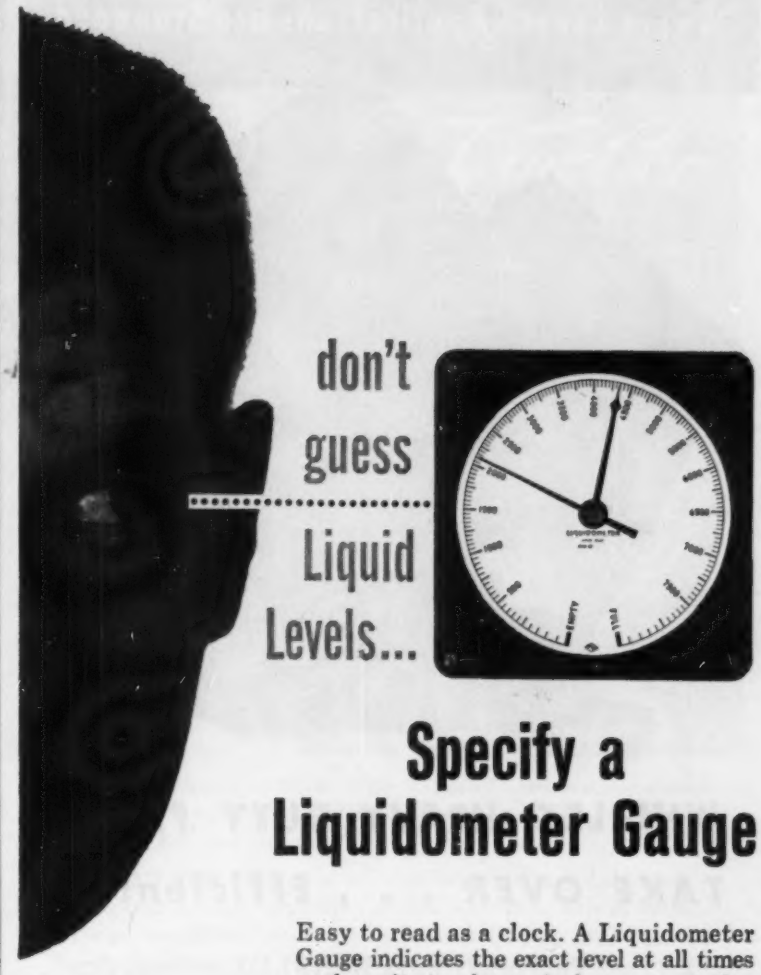


Specify a Liquidometer Gauge

Easy to read as a clock. A Liquidometer Gauge indicates the exact level at all times ... shows it at a glance. And gauge operation is completely automatic—as far as 250 feet from the tank—without need for auxiliary power of any kind.

A Liquidometer Tank Gauge measures virtually any liquid. It's simple to install—requires no maintenance. Many have provided over 30 years of efficient, dependable service. All are approved by Underwriters' Laboratories and Factory Mutual.

Whether your gauging needs require an automatic Liquidometer Gauge, a hydrostatic Levelometer or a tank-site-indicating Direct Reader, you'll get the best by specifying Liquidometer. For complete details write Dept. R.

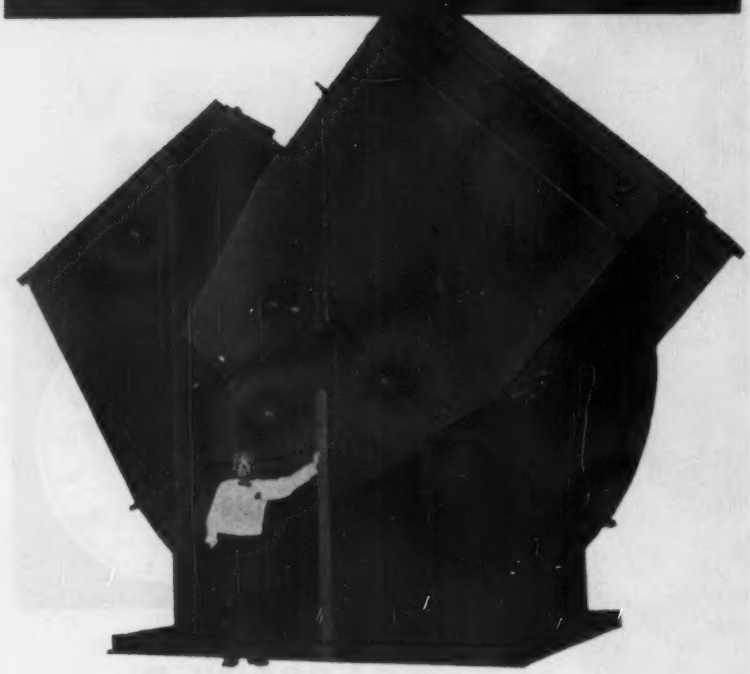
Since 1920 ...of proven quality

THE LIQUIDOMETER CORP.

LONG ISLAND CITY 1, NEW YORK

For more facts circle 316 on Reader Service card, p 117

Where Severe Applications are Standard



WHIRLEX HEAVY DUTY FANS

TAKE OVER . . . Efficiently

This heavy duty WHIRLEX exhaust fan was custom designed for iron ore sintering machine. The unit is designed to carry hot gases at the rate of 200,000 CFM with 35 in. W.G. static pressure and is complete with scroll liner, cheek plate liner, blade wear pads, inlet louvre control dampers and removable section.

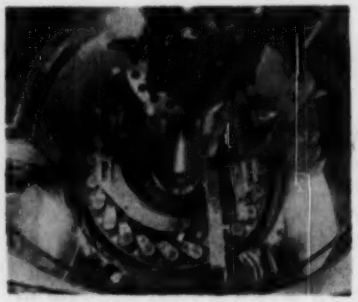
Additional facts and operating data on this and other WHIRLEX custom design fans are available at your request.

Fly Ash Arrestor
CORPORATION
204 North 1st. Street • Birmingham, Ala.

Dust Collectors • Induced Draft Fans
Forced Draft Fans • Exhaust Fans
Self Supporting Stacks • Duct Work

FLY ASH WHIRLEX ARRESTOR

Reports from the field



Canadian hydro plant is North American giant

Most powerful hydraulic turbines in North America, 20% more powerful than the units at Grand Coulee on the Columbia River, are now in operation at the Chute-des-Passes power plant in Northern Quebec. First two 200,000-hp units of five designed by the English Electric Company Ltd in Rugby, England are now in service. The five were ordered to provide additional electricity for the smelters of Aluminum Company of Canada Ltd. They were built by the John Inglis Company Ltd in Toronto, a member of the English Electric Group.

The $150,000,000 project is expected to come into full operation soon. Its peak output of 1,000,000 hp will increase capacity of Alcan and its affiliates' Saguenay Hydroelectric system in Northern Quebec to hp capacity of 3,600,000.

Governors for the vertical turbines are magnetic-amplifier type. This lets all five turbines in the power station be controlled together as a single machine. System is relatively new to North America and the Chute-des-Passes power station is the first million-hp plant to use it.

In keeping with size of turbines, the Chute-des-Passes development itself is a mammoth. It is 470-ft long, 70-ft wide and 109-ft high, hewn out of solid rock some 450-ft below the earth's surface. Water for the turbines is channeled through a 6-mile-long concrete-lined tunnel 34 ft in dia from nearby Lake Peribonka.

Begins on page 170

Natural heating found on site of proposed building

When drilling began for construction of a 6-story building in Hamilton, New Zealand, a supply of water at 72 F was discovered after a test bore had been sunk to 400 ft.

A plan to heat the building with underground water was put into effect and approved. Water will be heated or cooled on a reverse-cycle process, according to the season of the year, and then distributed throughout the building.

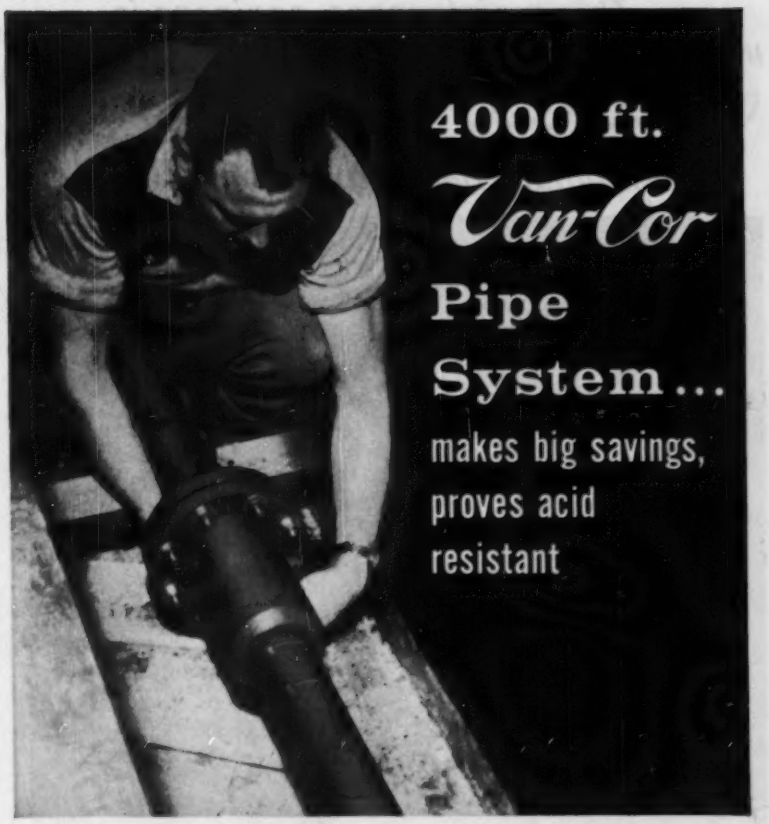
According to G B Bell, consulting engineer, it will cost less to heat the building with electrically driven compressors than with gas or oil. The water will pass through condensers in summer and evaporators in winter allowing refrigerating compressors to be worked for both heating and cooling.

Steel frame will house giant turbine-generator

A 3600-rpm turbine-generator now under construction at a Westinghouse Electric Corporation plant will be housed in this 14x30-ft steel frame. Rated at 384,000-kv amp, the completed unit is scheduled for delivery at Arkansas Power and Light Company's new station this summer.

A 325,000-kv steam turbine will drive the generator.

continued



At the Allentown (Pa.) Works of the Western Electric Co., the entire waste acid disposal system in the recent addition consists of Van-Cor rigid PVC pipe and fittings.

HOW COSTS WERE CUT. Initial price of Van-Cor was ⅓ that of comparable cast iron alloy pipe. On a 6" line, labor costs were estimated at 29¢ per foot of run—about half that of metallic pipe. Also, because Van-Cor has only 1/10 the weight, no mechanized handling equipment was needed. Available in 10 or 20 ft. lengths, Van-Cor requires fewer joints, and eliminates the breakage problem.

CORROSION LICKED. Van-Cor pipe was used because "corrosion resistant" cast metallic pipe had performed short of expectations in an adjacent building. After 1½ years service, the Van-Cor system is in excellent shape, unaffected by such acids as hydrofluoric, hydrochloric, sulphuric, nitric and many plating solutions.

Investigate Van-Cor Pipe, Fittings, Valves, Electrical Conduit, and Fabrications . . .

Write for Catalog and Name of Nearest Distributor

INDUSTRIAL DIVISION OF
COLONIAL PLASTICS MFG. CO.
Subsidiary of THE VAN DORN IRON WORKS CO.
2685 EAST 79TH STREET CLEVELAND 4, OHIO

For more facts circle 318 on Reader Service card, p 117

This maintenance engineer is

"Seveneering" with R/M

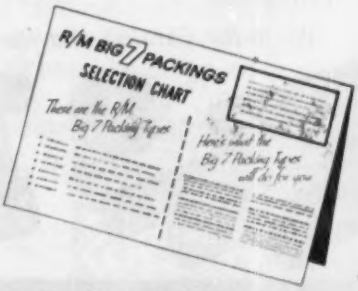
to eliminate packing selection error

He is using Type #1 (Universal Plastic Packing). This packing meets the requirements of not just one pump, not just two pumps, but many kinds of pumps. R/M Type #1 Packing has the following characteristics: (1) low friction; (2) resistance to materials handled; (3) resistance to pressure; (4) resistance to heat.

Whenever you are packing a pump, you want a packing that has the above characteristics. R/M Type #1 is called Universal because it packs a wide variety of pumps better than any other packing. Join the thousands of maintenance men that are "Seveneering" with R/M. They are using the Big 7 packing types to make sure that each packing is engineered for the job it has to do. Remember this: there are only 7 packing types to select from and as a rule, 3 or 4 types take care of most plants' needs without compromise. This eliminates packing selection error.

R/M Big 7 packing types will do your job extremely well. Call your local R/M distributor today. He will be able to give you service immediately from his own stock, readily supplemented by any one of the R/M warehouses strategically located. Write now for your R/M Big 7 Packings selection chart.

Send for this new R/M Big 7 Chart for quick reference →



R/M

BIG 7 PACKINGS

RAYBESTOS-MANHATTAN, INC.
PACKING DIVISION, PASSAIC, N. J.
MECHANICAL PACKINGS AND GASKET MATERIALS

Reports from the field

Begins on page 170

Burndy Corp plans Belgian plant

A new plant to manufacture electrical connectors for users in the Common Market nations was announced by Sidney Wolberg, vice-president—overseas operations of Burndy Corp. Scheduled for completion in spring of 1960, the Malines, Belgium plant will be built of steel, glass and concrete.

A Belgian feature will be a covered bicycle rack for the workers' transportation. Plant will serve offices across Western Europe including Antwerp, Zurich, Cologne, Rotterdam, Stockholm, Oslo, Copenhagen, Hamburg, Berlin, Karlsruhe, Nurnberg, Milan and Turin.

Kentucky plant boasts giant boiler, generator

Tennessee Valley Authority has awarded contracts for two huge steam-electric-plant boilers at a total cost of $26.8 million. Combustion Engineering, Inc was awarded a contract of $12,058,950 for a boiler to be used with a 500,000-kw generator. The Babcock & Wilcox Company received a $14,804,610 contract for the boiler required for the initial 600,000-kw General Electric generating unit to be installed at TVA's new Paradise steam plant in western Kentucky. This

For more facts circle 319 on Reader Service card, p 117

Steam trap dependability is a matter of what the manufacturer puts into the trap

ARMSTRONG TRAPS ARE DESIGNED AND MADE TO GIVE YOU DEPENDABILITY

1. Efficient, proved operating principle

Armstrong Traps provide the most advanced development of the time-proven inverted bucket principle. Simple, but effective, there isn't much that can go wrong.

2. Good design

Armstrong Trap design gives big capacity in a small package. The mechanism is virtually fool-proof. All body styles are easy to inspect and maintain without removal from the line.

3. Highest quality materials of construction

Only the best goes into Armstrong Traps. Bodies are close grained 30,000 tensile iron castings or high quality forgings. Working parts are all tough, corrosion resistant stainless steel.

4. Good workmanship

Armstrong Traps are made by craftsmen who take pride in their work. Careful inspection and frequent checking insure the quality of the trap.

5. Application know-how

Your problem has probably been solved already in the extensive experience of the Armstrong engineering and sales organization. You can be sure of sound, dependable recommendations.

Your local Armstrong Representative can show you what Armstrong dependability can do for you. Call him today or write direct.

860 Series for low pressure heating service.

800 Series, side inlet, side outlet.

No. 801, side inlet, bottom outlet.

880 Series, integral strainer.

200 Series, bottom inlet, top outlet.

Forged Steel Series for high pressures, high temperatures.

The 48 page Armstrong Steam Trap Book tells how to correctly size, install and maintain steam traps for any pressure, any temperature, any load plus full catalog data on Armstrong Steam Traps. Ask for Catalog K.

ARMSTRONG MACHINE WORKS

8122 Maple Street Three Rivers, Michigan

For more facts circle 320 on Reader Service card, p 117

the V-notch

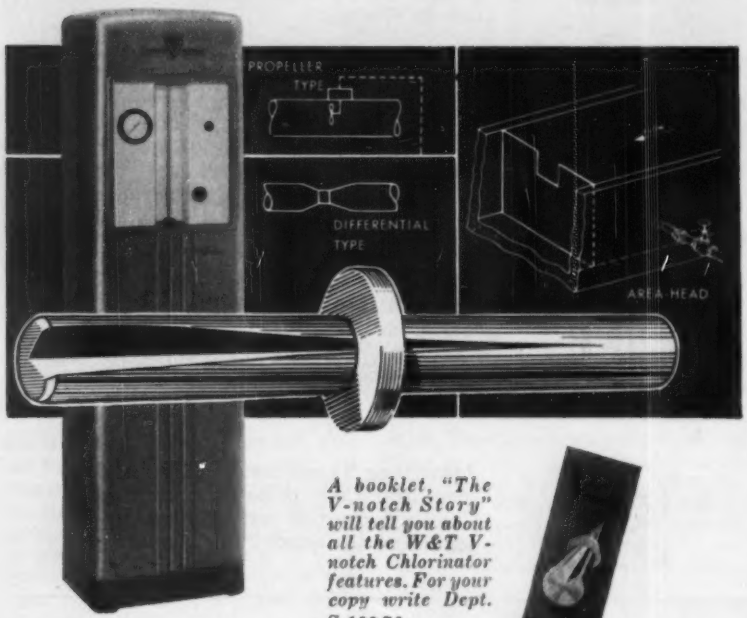
ready and waiting for your signal

Lots of jobs are done better automatically. Changing chlorine feed rate is now one of them. With the V-notch...the straight line metering action of the plug through the ring makes automation simple.

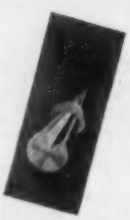
Merely by adding, not adapting, a W&T V-notch Chlorinator can give you any degree of automatic control you want—step rate, start-stop, program, proportional, even residual control.

With a V-notch Chlorinator any signal from any primary metering device can control chlorine feed. So anyone can afford automation.

And, of course, the right plastics make the whole chlorinator chlorine-proof.



A booklet, "The V-notch Story" will tell you about all the W&T V-notch Chlorinator features. For your copy write Dept. S-133.76.



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25 MAIN STREET, BELLEVILLE 9, NEW JERSEY

W&T DRY CHEMICAL FEEDERS

For Accurate Feeding Of Water Treatment Chemicals

Full line of wide range dry chemical feeders capable of controlling a few ounces to 3000 lbs. per minute.

Write for Bulletin M-38 for complete Dry Feeder information.

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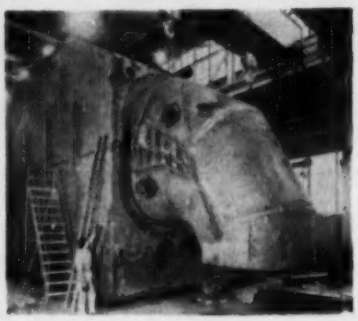
25 MAIN STREET, BELLEVILLE 9, NEW JERSEY

Reports from the field

Begins on page 170

boiler as well as the 600,000-kw generator may be the largest ever made for a steam-electric plant.

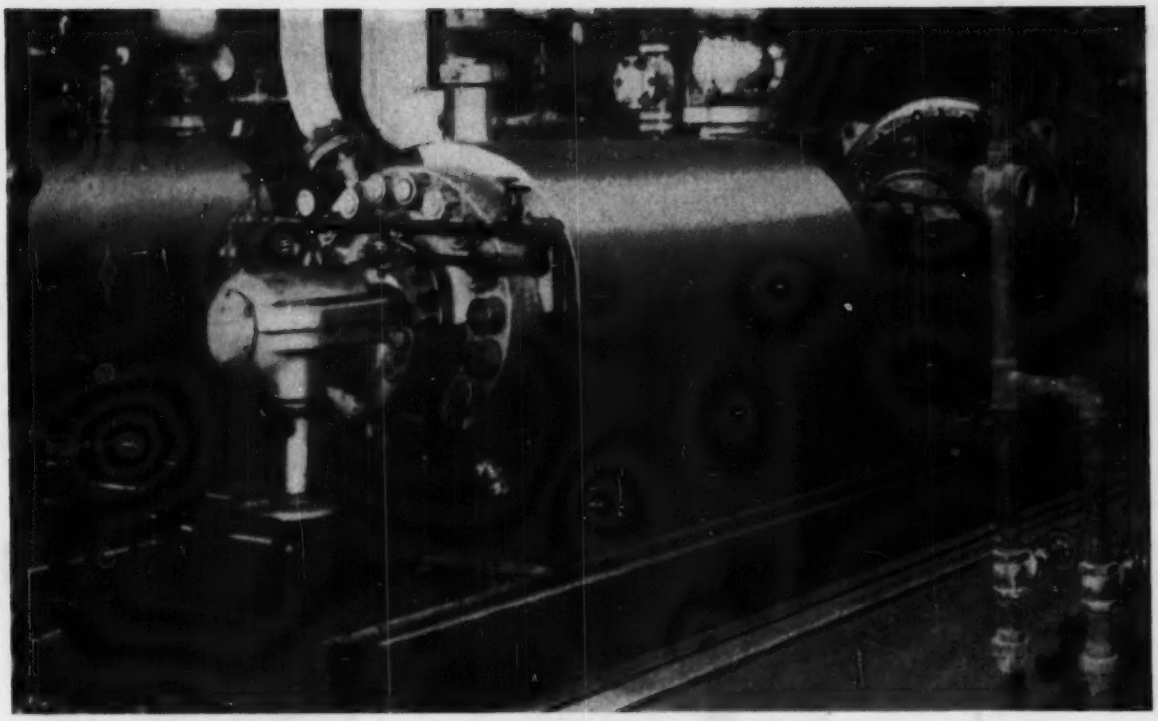


Giant surface condenser delivered to Southern utility

Giant 110,000-sq-ft surface condenser was recently delivered to Louisiana Power and Light Co for installation at the Little Gypsy steam-electric station. Unit is designed to condense 1,410,000 lb steam per hr with a backpressure of 2.65 in. of mercury absolute. Condenser was completely fabricated and aligned in shell components prior to shipping. According to condenser's builder, American-Standard, special modular construction of unit will greatly reduce erection time at the power-station site.

Instrument magnifies light 50,000 times

An instrument which can intensify light 50,000 times and illuminate optical images invisible to the naked eye to the point where they can be seen and photographed has recently been introduced in Great Britain. Developed by a small group from the Imperial College of Science in London, it is believed to be the first device of its kind to be seen in the Western world. Scientists are going to try to observe the geometrical shape of the



What to look for in shafts for today's high speed-high pressure pumps

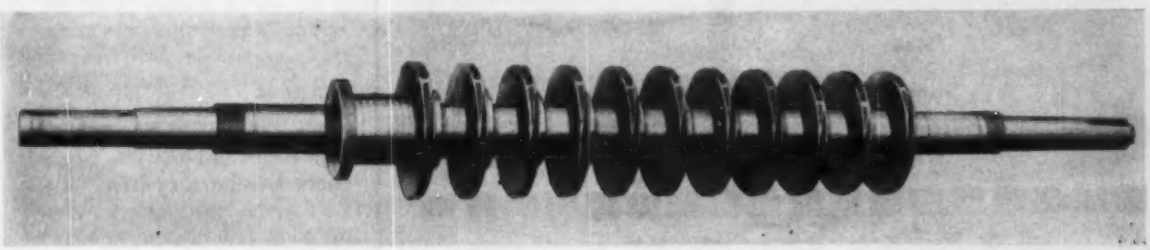
In this era of soaring speeds and pressures, metals for pump shafts must have greater strength and hardness plus higher fatigue resistance. And they must be able to give trouble-free service for long periods under heavy loads.

"K" Monel* age-hardenable nickel-copper aluminum alloy is one alloy which offers *all* of these properties:

- **High strength,** stiffness, and torsional properties to transmit power with minimum vibration. In "K" Monel, the designing engineer has found a non-ferrous alloy that has a high strength not offered by other corrosion-resisting alloys available at comparable price levels.
- **Hardness** to resist abrasion and scoring. This means more protection against shaft wear—longer bearing life.
- **High fatigue resistance.** "K" Monel has remarkable resistance to repeated stresses a high speed pump shaft has to undergo.
- **Corrosion resistance.** This nickel-copper alloy resists corrosion, pitting, and corrosion fatigue in waters of all sorts.
- **Galvanic neutrality,** when coupled with bronze pump bodies and bearings, or cast Monel impellers.
- **Non-Magnetic.** "K" Monel is non-magnetic under ordinary conditions, and remains so down to −150°F.

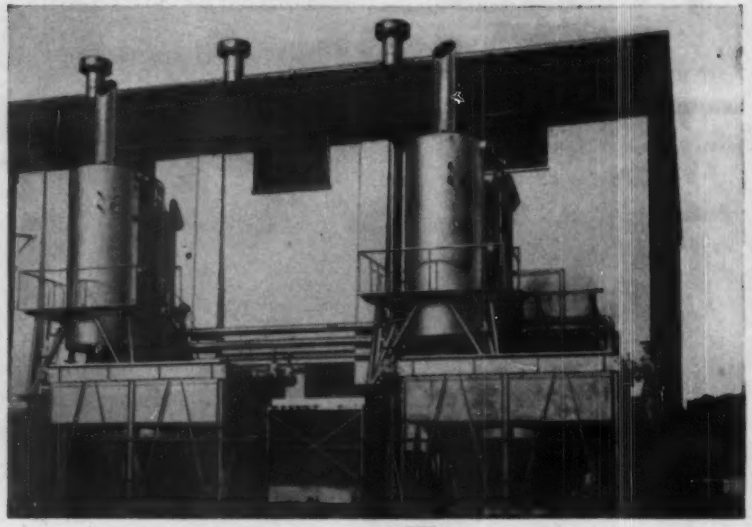
You'll find all the essential engineering data in the 28-page reference manual, "Engineering Properties of "K" Monel and "KR" Monel". We'll be glad to send you a copy. *Inco trademark

HUNTINGTON ALLOY PRODUCTS DIVISION
The International Nickel Company, Inc.
67 Wall Street New York 5, N. Y.



"K" MONEL®

For more facts circle 322 on Reader Service card, p 117



MAXIM

silencers help Florida power plant reduce costs

The New Smyrna Beach municipal power plant has two new 2500 HP Enterprise Turbocharged Diesels. They burn heavy, low-cost residual fuel at a considerable saving. However, this fuel requires pre-heating. Maxim Heat Recovery Silencers efficiently capture waste heat from the diesel exhausts and pre-heat the fuel—at virtually no operating cost.

Maxim Heat Recovery Silencers provide the optimum in noise suppression—residential degree silencing. They can be run wet or dry, permitting continuous use of engines even if the need for waste heat is intermittent.

Maxim offers vertical and horizontal models for a wide range of conditions and capacities—the most complete line available. Write for full information.

EMHART MANUFACTURING COMPANY
MAXIM DIVISION
BOX 216, HARTFORD 1, CONN.

EMHART

60

Emhart Manufacturing Company
Maxim Division
Box 216, Hartford 1, Conn.

Please send bulletin on Maxim Heat Recovery Silencers.

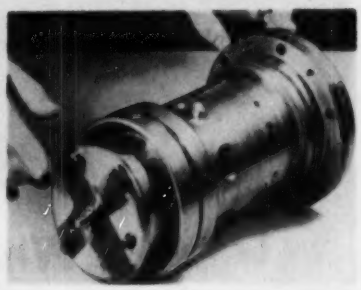
name

company

address

track of nuclear particles with this instrument.

Although this device is not original in concept, its method of construction is entirely new. It is designed to multiply the brightness of a faint image by combining multiplication of light with adequate definition. It can turn the smallest pulse of light energy into a flash that is visible and the image into a pattern that is discernable.



Turbine overspeed limiter recently installed

A runaway speed limiter for turbines permits rapid change in blade angle to reduce rotational speed due to water flow. Developed by Allis-Chalmers Mfg Co, the unit was recently installed at the Camargos Development of CEMIG in Brazil and the Cochrane Development of Montana Power Company. Limiter is made up of a group of oil bypass valves located at accessible positions in the blade servomotors of the shaft. Maximum "off-cam" runaway speed is approximately 2.5 to 3.0 times normal speed.

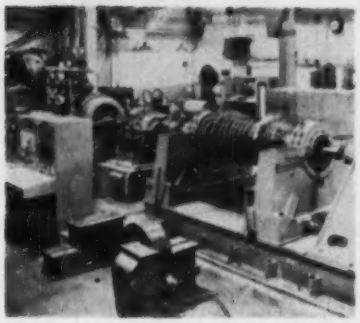
Calcium-lead alloy increases battery life

An alloy of lead-antimony has been used as a battery grid, giving service life of 14 years. Substitution of calcium as the alloy, however, has increased life of battery to 25 years,

Begins on page 170

according to R C Shair of Gulton Industries, Inc.

In addition to supplying an amp-hr reserve in case of emergency, batteries act as a cross-talk or noise filter, Shair pointed out. His paper, *Lead-acid storage batteries in telephone service*, was presented at a symposium on storage batteries.



Balancing machine handles 7 tons at 12,000 rpm

De Laval Steam Turbine Company has recently installed a balancing machine which is claimed to be the largest in the U.S. Machine is capable of balancing 7-ton rotating units at 12,000 rpm and is sensitive to bearing vibrations of the order of 4-millionths in. displacement of gravity. This unit is said to be able to readily detect, on a 5500-lb rotor spinning at 4000 rpm, unbalance as small as one gram at a 10-in. distance from the axis of rotation.

De Laval expects to use its new machine for minimizing vibration of high-speed turbine rotors, barrel-pump rotors, compressor rotors, wheels and gear pinions, quill shafts and shaft extensions.

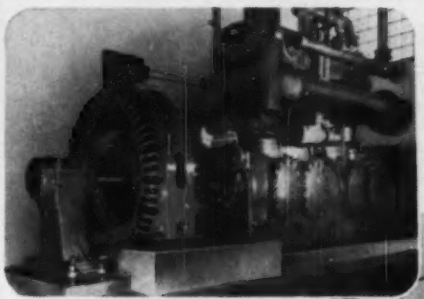
The machine is presently operating on De Laval's test floor, driven through a dual-range speed-increasing gear by a special steam turbine. Later, it will be reinstalled in a vacuum chamber to make possible high-speed precision balancing of turbine and compressor wheels.

No name among American makers of cooling equipment stands higher or has endured longer than that of Frick.

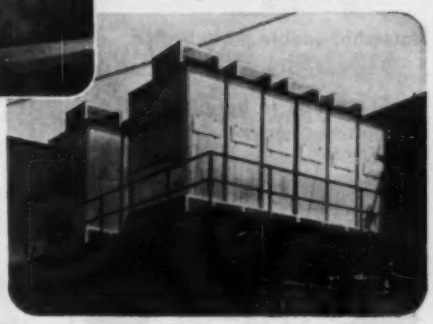
Back of the Frick trademark are 107 years of experience in engineering, 78 in refrigeration and ice making, and 55 in air conditioning. You get the value of this priceless experience when you invest in dependable Frick equipment.

Write, wire or phone now for catalogs and estimates.

FRICK COMPANY,
Waynesboro, Penna.

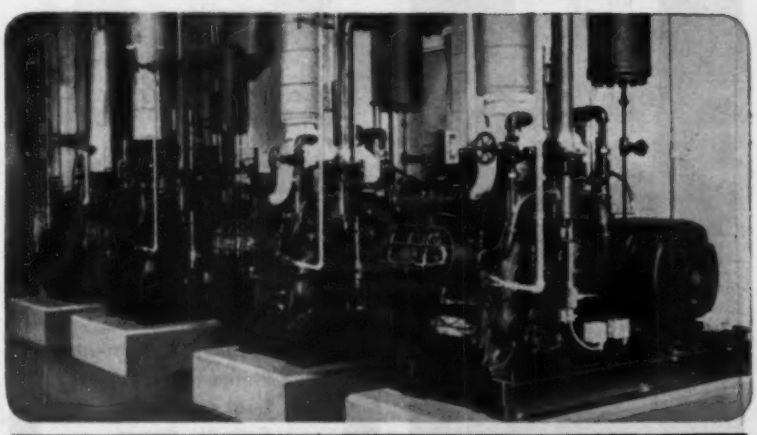


ABOVE—Frick heavy-duty compressors are the standard of the world for industrial work. Ask for Bulletin 112.



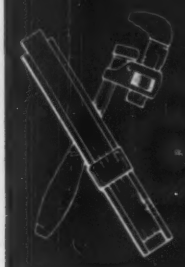
RIGHT—These Frick evaporative condensers are saving $1,000 per month. See Bulletin 235.

BELOW—Frick "Eclipse" compressors have 2, 3, 4, 6 or 9 cylinders, offer speeds up to 1200 r.p.m. See Bulletin 100.



DEPENDABLE REFRIGERATION SINCE 1882
FRICK CO.
WAYNESBORO, PENNA., U. S. A.

For more facts circle 324 on Reader Service card, p 117



YOU GET EVERYTHING THE ENGINEER & MAINTENANCE MAN ASKED FOR IN THIS NEW LIGHT WEIGHT, COMBINATION STEAM TRAP!

Fast warm up through rapid removal of both air and condensate up to 10° F. of saturation.

●

Continued discharge of air and condensate at steam temperature.

●

Built-in filtration of solids

●

Easy access to all working parts

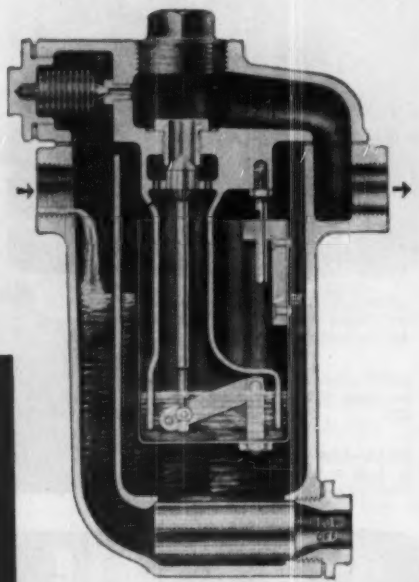
●

Interchangeable main orifice

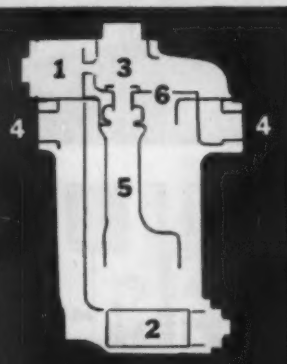
●

Light enough to be supported by line

Step by step steam traps have been improved, making them compact, lighter and more efficient, easier and faster to service. Now Wright-Austin has incorporated all these advances into one of their proven vertical bucket-type traps—the new 500-C series. Write for literature.



500-C Series—For ½" to 2" pipe lines; Pressures to 150 PSIG; Capacity to 30,000 lbs./hr.



1. Monel thermostat air by-pass
2. Monel strainer
3. Valve seat accessible through inspection plug
4. Straight-through pipe connections
5. All operating parts stainless steel
6. Working parts removed with cover

For fast and continuous heat in:

Unit heaters
Hot water heaters
Steam mains
Laundry equipment
Platen presses
Heat exchangers
Cylinder dryers
Jacketed Kettles
Sterilizers
Evaporators

WRIGHT-AUSTIN COMPANY
3245 WIGHT STREET • DETROIT 7, MICH.

Appointments

Management changes

Thomas C Jones

An Aluminum Company of America executive for over 40 years, and former manager of its Chicago district, Thomas C Jones is new president of the Nalco Chemical Company. Mr Jones graduated from Case Institute of Technology. He has been a member of the Nalco board of directors since 1953 and on the company's executive committee since 1954.

Former president Joseph A Holmes is now vice-chairman of the board of directors.

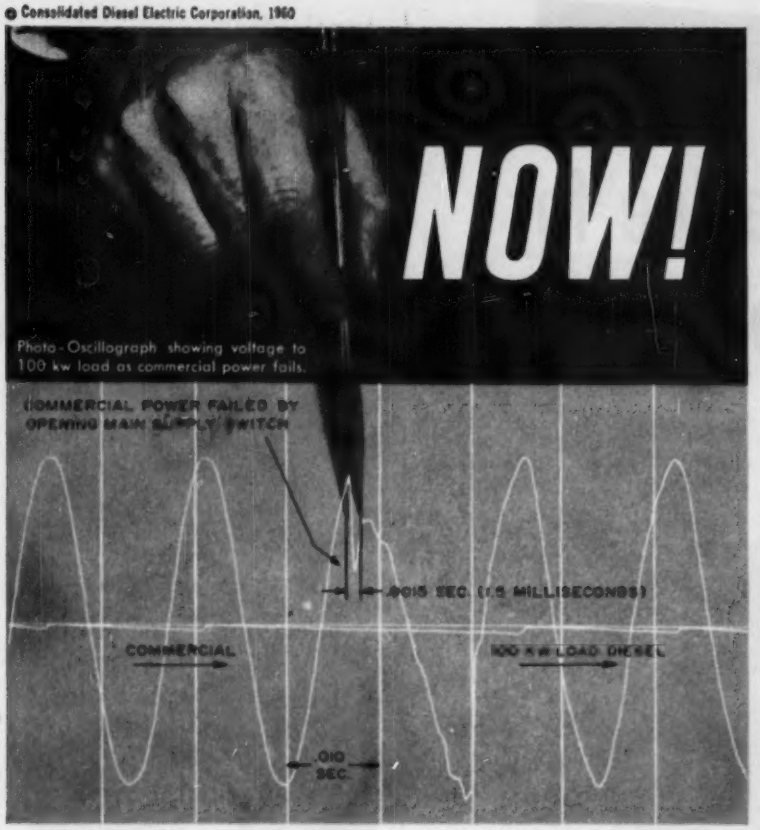
Robert W Dickinson

Atomics International's Sodium Reactor Dept will be directed by Robert W Dickinson. A former commander in the U.S. Navy, Dickinson joined Atomics International in 1956. He served with the Navy Dept's Bureau of Ships and the AEC in development of nuclear power for marine application.

In his new position he will be responsible for design and development of sodium-cooled nuclear reactors for power production. These include Sodium Reactor Experiment operated for AEC and Advanced Epithermal Thorium Reactor, a power reactor now being developed for Southwest Atomic Energy Associates.

continued

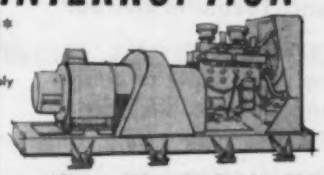
© Consolidated Diesel Electric Corporation, 1960


NOW!
Photo-Oscillograph showing voltage to 100 kw load as commercial power fails.
COMMERCIAL POWER FAILED BY OPENING MAIN SUPPLY SWITCH
.0015 SEC. (1.5 MILLISECONDS)
COMMERCIAL
100 K.W. LOAD DIESEL
.010 SEC.

If continuous power is critical, you get

POWER WITHOUT INTERRUPTION with CONDEC'S UPS*

*Uninterrupted Power Supply



Unlike conventional standby generator units, Condec's Uninterrupted Power Supply means power without interruption whenever prime source fails. Controls, relays, lights, radar scopes, computers don't even flicker or pause.

This instantaneous transfer, from prime to UPS generation, with full voltage restoration in 1.5 milliseconds provides the every-second power protection essential to key industrial operations like processing, telemetering, pipelines, automated production lines, as well as such military uses as communications, radar, aircraft and missile ground support.

What the Condec UPS does for you

- Automatic emergency power 5 to 200 kw without interruption.
- Full voltage restoration in 1.5 milliseconds with full load on alternator.
- Frequency maintained within 3.5 per cent during transition. Frequency regulation within 1 per cent during operation.
- No transient frequency during load changes.
- Precise voltage regulation guaranteed by static excitation and magnetic amplifier voltage regulator.
- Unattended operation. Automatic synchronization and automatic return to standby.

Patent Pending

FIND OUT FOR YOURSELF. *We'll be happy to arrange a demonstration. Or send for fully-documented brochure with complete technical data. Call or write today.*

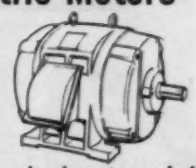
POWER EQUIPMENT DIVISION

THE CONDEC GROUP

880 CANAL ST. • 15519 LANARK ST.
STAMFORD, CONN. • VAN NUYS, CALIF.

CONDEC Products for Power

Lima Electric Motors

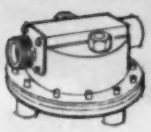


Electrical drives for any application in the 1-to-200 horsepower range. Over 8,000 different combinations of electric motors, gear reducers, gearhead motors, shaft mounted speed reducers, selective speed drives and variable speed motors.

Hammond Valves

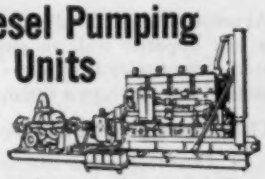
. . . A full selection of 550 models of gate, globe and check valves in bronze. Designed and produced to meet the most demanding specifications for industrial, government, domestic applications.

Consolidated Controls



. . . Precision instrumentation and control systems and their components including a complete line of pressure switches — from inches of water to hundreds of atmospheres — for controlling an electrical circuit in response to a variable pressure.

Diesel Pumping Units



. . . Complete pumping systems for crude oil, refined petroleum products, water and other fluids for continuous or emergency service. Stationary or mobile units.

A facilities and product brochure has been prepared to tell you in greater detail about THE CONDEC GROUP. Send for it today.

THE CONDEC GROUP*

880 CANAL ST. • 15519 LANARK ST.
STAMFORD, CONN. • VAN NUYS, CALIF.

*Consolidated Diesel Electric Corporation
Consolidated Controls Corporation
Consolidated Avionics Corporation
Hammond Valve Corporation
The Lima Electric Motor Co., Inc.

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For more facts circle 326 on Reader Service card, p 117

New fuel cut-out control by Reliance

Pipe one device for double protection

and add alarm for approaching low water level if desired...

Reliance Levalarm EA-100P

Using but one water chamber — one set of pipes to boiler — this new Reliance Fuel Cut-out and Alarm control gives you two efficient devices in one.

At one end (right hand above) a positive float-operated switch cut-out; at the opposite end, an electrode-type control using U.L.-approved transformer-relay hook-up — completely independent of the float-type control but employs a common water chamber.

Check these possible use-combinations of the Levalarm EA-100P:

1. Dual fuel cut-out control.
2. Float-operated fuel cut-out and electrode-operated low water level alarm.
3. Electrode-operated fuel cut-out and float-operated low water alarm.
4. Float-operated fuel cut-out and electrode-operated fuel cut-out and electrode-operated low water alarm.

This Levalarm is the convenient answer in cases where two independent fuel cut-outs are required.

And this Levalarm provides outstanding additional safety to the operation of factory assembled boilers.

Write today for full description of this new safety device.

The Reliance Gauge Column Company • 5902 Carnegie Avenue • Cleveland 3, Ohio

Reliance BOILER SAFETY DEVICES

Appointments

Begins on page 184

Dickinson graduated from the University of California and received master's degrees from the U.S. Naval Postgraduate School and Massachusetts Institute of Technology.

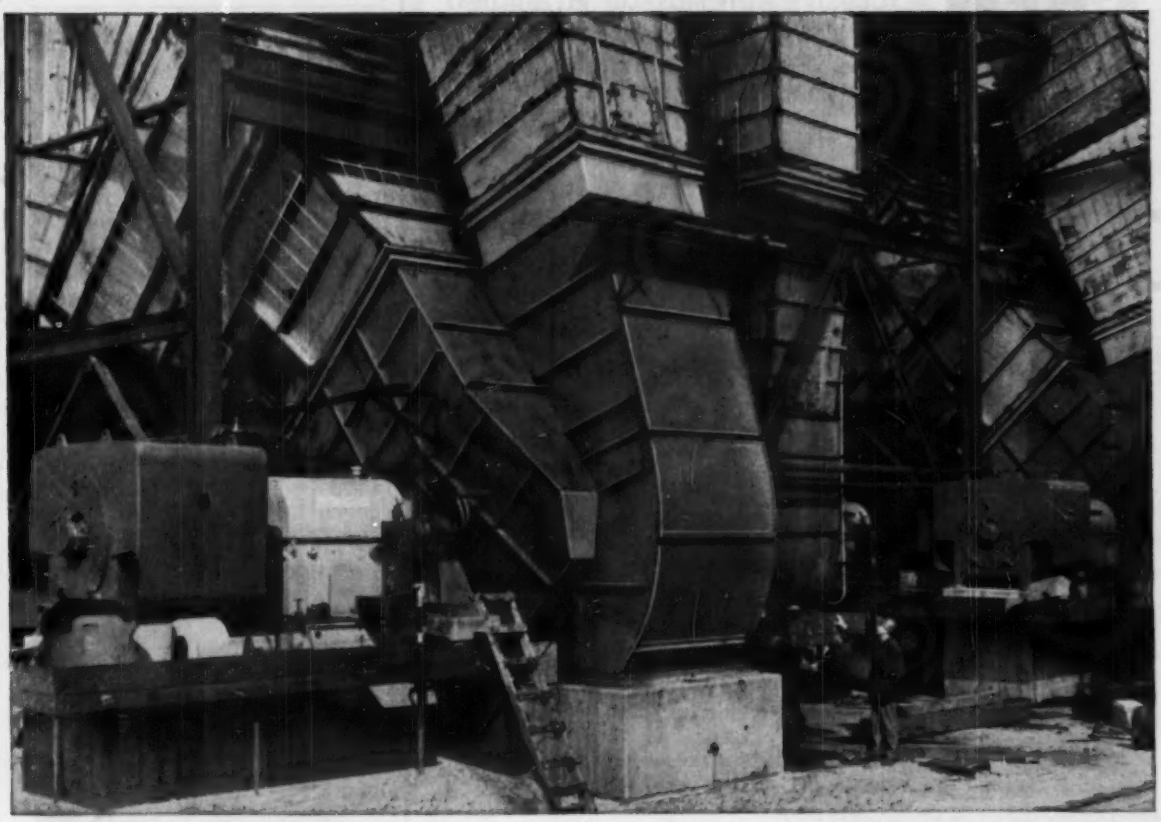
Dr Mostafa B Talaat

Nuclear Div of The Martin Company will have all research and development efforts in the field of energy conversion directed by an Egyptian-born engineer, Dr Mostafa B Talaat. He intends to concentrate particularly on methods of "direct conversion" in which one form of energy is transformed into another such as heat into electricity without the use of moving parts.

Dr Talaat came to this country shortly after receiving a BS degree in electrical engineering from the University of Cairo in 1946. He then earned a MS degree and doctorate in electrical engineering from the University of Pennsylvania and has taught at both the University of Pennsylvania and Massachusetts Institute of Technology.

Joseph Ferrante

Cornell-Dubilier Electric Corporation has appointed Joseph Fer-



HOW DO YOU SELECT MECHANICAL DRAFT FANS ?

By price alone? Undoubtedly not because proper fan performance cannot be obtained by cut-rate methods. It must be engineered and built to a standard, not a price.

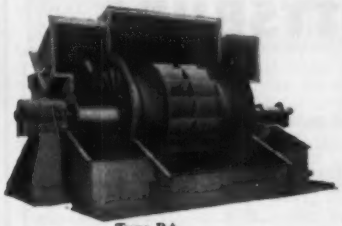
"Buffalo" Mechanical Draft Fans are built to an engineering standard with over 80 years experience and hundreds of installations to back it up. This engineering experience combined with "Q" Factor* construction makes the complete line of "Buffalo" Mechanical Draft Fans a best buy in the long run.

Be sure to phone your "Buffalo" Engineering Representative when you want reliable, high efficiency, long life mechanical draft fans.

*The "Q" Factor — the built-in Quality which provides trouble-free satisfaction and long life.

Type CR
Radial Blade Fan.

Type BLH
Backward Curve Fan.



Type BA
Airfoil Fan.

"Buffalo"

BUFFALO FORGE COMPANY

Buffalo, New York

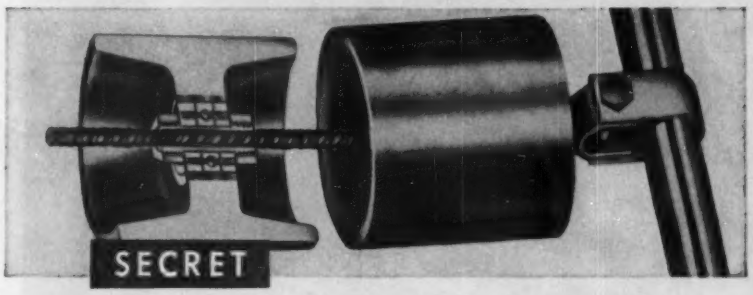
Buffalo Pumps Division • Buffalo, N. Y.

Canadian Blower & Forge Co., Ltd., Kitchener, Ont.

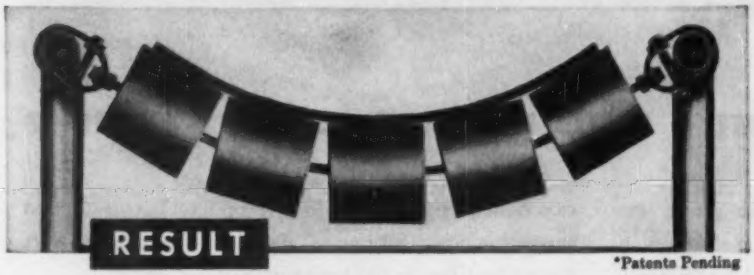
VENTILATING • AIR CLEANING • AIR TEMPERING • INDUCED DRAFT • EXHAUSTING • FORCED DRAFT • COOLING • HEATING • PRESSURE BLOWING

For more facts circle 328 on Reader Service card, p 117

NEW (EXCLUSIVE WITH McNALLY PITTSBURG) CONVEYOR DESIGN ... slashes maintenance cost! ... extends belt life!



... of the amazingly improved efficiency of this modern belt conveyor is shown here. This new McNally Pittsburg Cradle Idler* consists of 5" rubber rollers assembled on precision ground ball bearings, prelubricated and lifetime sealed. Being a *true catenary* suspension with rollers mounted on flexible, *non-rotating* stainless steel wire rope, this design eliminates "loping" and dangerous harmonics.



*Patents Pending

... is greater capacity and faster belt operation with minimum spillage. Since the belt lies in true arc with no creases or bends to cause wear, *belt life is substantially increased.* Because this McNally Pittsburg conveyor design is so simple, costs are lower, and erection time is reduced.

WRITE TODAY for details on the new conveyor which costs less to install ... *saves money every day it is in use.*

McNALLY · PITTSBURG

McNally Pittsburg Mfg. Corp.
Dept. PO, Pittsburg, Kansas

☐ Please send information on the new McNally Pittsburg belt conveyor.

☐ Have Sales Engineer call for further consultation.

Name_____ Title_____

Company_____

Address_____

City_____ State_____

Appointments

rante Director of Research for their Research Laboratory. He was formerly engineering vice-president at Tobe Deutschman Corporation.

A graduate of the University of Massachusetts, he is well known in fields of energy-storage capacitors, filtering systems, pulse networks and related systems. Scylla, a hydrogen-fusion device unveiled at the historic Geneva Atoms-For-Peace Conference, uses capacitors designed by him.

Marvin Lane

Graver Water Conditioning Company's former technical director, Marvin Lane, has been named general manager of the division of Union Tank Car Company. Lane's past work in the water-treatment field includes work on the first dialysis liquid-purification system for acids, purification equipment for power-plant condensate, noncorrosive underdrains for gravity filters and subfill-less underdrains for ion-exchange units. He was instrumental in developing USP-quality water through silica removal by ion exchange and conducted the first field tests on commercial equipment for this purpose.

Allis-Chalmers Mfg Company: D Dalasta, head of static relay section,

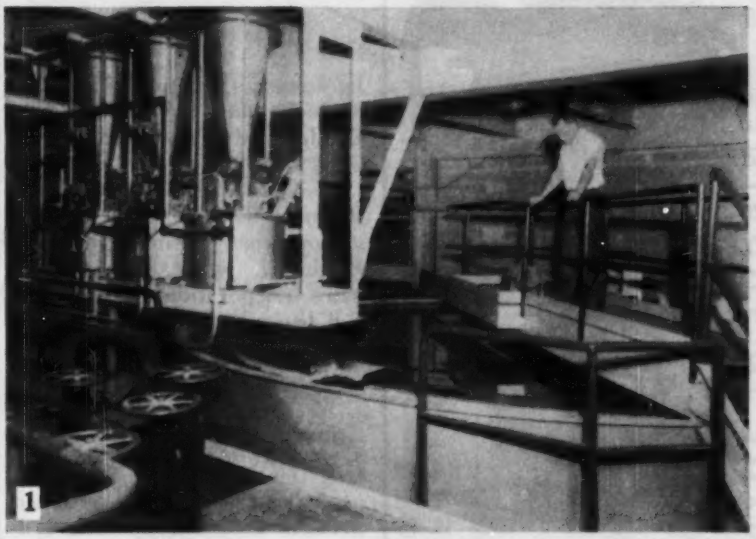
Begins on page 184

switchgear dept. **American-Standard:** R J Riedl, product manager—heat exchanger dept. **Avnet Corp:** B H Berman, executive assistant. **Borg-Warner Corp,** Roy C Ingersoll Research Center: J R Madigan, Senior Scientist. **Chemetron Corp, Tube Turns Div:** J M Gloor, works manager; H H George, chief engineer, product engineering and research dept.

Chapman Valve Mfg Company. F D Crowther, vice-president and general manager. **Daystrom Inc, Daystrom Transicoil Div:** E J Querner, manager of manufacturing. **Dresser-Ideco Company:** J L Pausch, chairman; H Knippenberg, president and general manager. **General Electric Company:** Dr H A Cataldi, supervisor of physical chemistry — Materials and Process Laboratory; Dr C E Reed, general manager—Chemical and Metallurgical Div. **General Precision Laboratory, Inc:** Dr F A McMahon, manager of service and support dept; J A Hawthorne, manager of industrial distribution; R G Johnson, vice president.

General Controls Company, Hammel-Dahl/Foster Engineering Div: J R Curran, divisional vice-president and general manager. **Halex, Inc:** E Mills, director. **H K Porter Company, Inc, Leschen Wire Rope Div:** R H Bragg, production control manager. **Jergens Tool Specialty Co:** J H Schron, president; N J Redmond, vice-president of manufacturing. **Keasby & Mattison Company:** R S Hartman, manager of planning and inventory control. **Magnetic Research Corp:** A L Scharff, general manager. **Miniature Precision Bearings, Inc:** H S Ferguson, board of directors. **Nalco Chemical Company:** Dr A J Freedman, project leader of Cooling Tower Research. **Ohio Edison Company:** D B Mansfield, E F Dissmeyer—vice-presidents. **Springfield Boiler Company:** D W Mattimore, supervisor of water tube boiler erection. **Thompson Ramo Wooldridge Inc, Ramo-Wooldridge Div:** Dr A D May Jr, member of

FLUIDICS* AT WORK



How new McMeekin Station treats its boiler water

Raw lake water from Lake Murray is the source for boiler feed at the new Silas C. McMeekin Station of South Carolina Electric and Gas Co.

Here's what the water analysis looks like:

Silica	9.0 ppm
Iron	0.8 ppm
Turbidity	15.0 ppm
Colorants	35.0 ppm
Electrolytes	50.0 ppm

Hardly the sort of water you put in a boiler operating at 2450 psig. So you'll find a complete Permutit water treatment system at McMeekin Station. Gilbert Associates, Inc., Reading, Pa., consultants on this job, report current results from the equipment as follows:

1. Precipitator and chemical feeders lower iron to 0.2 ppm, turbidity to less than 5 ppm, colorants to 2 ppm.

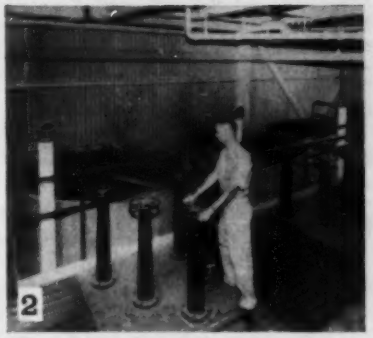
2. Three gravity filters further reduce turbidity to less than 1 ppm.

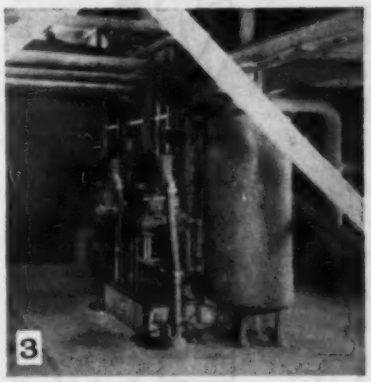
3. Complete demineralization plant, cation and anion exchangers lower the scale-forming silica to an inoffensive .02 ppm, electrolytes to .75 ppm.

4. Fully automatic Permutit control cubicle (not illustrated) remotely controls, monitors and records systems operation at all times.

Such complete water treatment is typical of a Permutit installation and of the all-round service you get from our FLUIDICS program. If you have a boiler feed water problem, for example, our Permutit Division can provide everything you require from initial survey to final equipment system.

For more information, write PERMUTIT, 50 West 44th Street, New York 36, N. Y., or call your local Permutit representative.

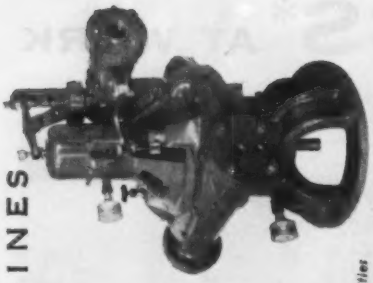


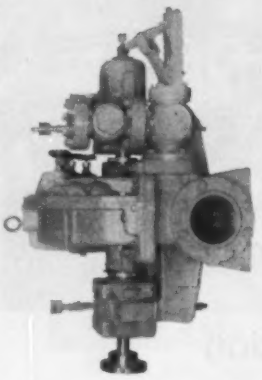


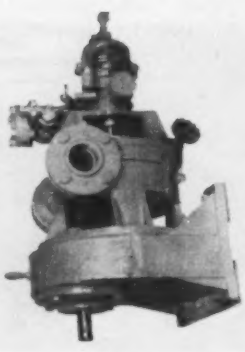
*FLUIDICS is a complete, imaginative Pfaudler Permutit program which economically provides practical answers to problems involving liquids and gases.

PFAUDLER PERMUTIT INC.
Specialists in FLUIDICS...the science of fluid processes

For more facts circle 330 on Reader Service card, p 117







FOR 40 YEARS . . . THE QUALITY NAME IN TURBINES

CARLING TURBINE BLOWER CO. 7 NEBRASKA ST. WORCESTER, MASS.

WRITE FOR BULLETIN 30-C-3

Representatives in Principal cities

CARLING TURBINES

Appointments

Begins on page 184

Intellectronics Laboratories. **Triangle Conduit & Cable Co, Inc, Conduit and Armored Cable Div:** G J McMahon, plant manager. **United States Rubber Company, Research Center:** Dr E M Bevilacqua, senior research scientist; R H Hugger, senior dept manager. **Vitro Corporation of America:** F B Jewett Jr, president; J C Ward Jr, chairman of board.

Consultant changes

L L Denson: consulting engineer, mechanical engineering. **Ebasco Services Inc:** C E Anderson, H P Richmond, P L Gill, New York office, C J Sammond, Dallas office R M Holmes—Washington D C office. **General Precision Laboratory Inc:** Col B Balchen.

Recent purchases and mergers

Allis-Chalmers Mfg Company: Incorporation of The Valley Iron Works Company. **A P Green Fire Brick Company:** acquisition of Dixie Fire Brick Company, Inc. **Beckman Instruments, Inc:** acquisition of Harold Kruger Instruments and Tool-Lab, Inc. **Crane Co:** acquisition of Pipe Fabricators, Inc and Canadian Pittsburgh Piping Ltd. **Maine Public Service Company:** purchase of Washburn Electric Company. **Snap-on Tools Corp:** acquisition of outstanding common stock of Judson Engineering Corporation. **Sun Chemical Corporation:** purchase of Facile Corporation. **Thompson Ramo Wooldridge Inc:** acquisition of Radio Industries, Inc.

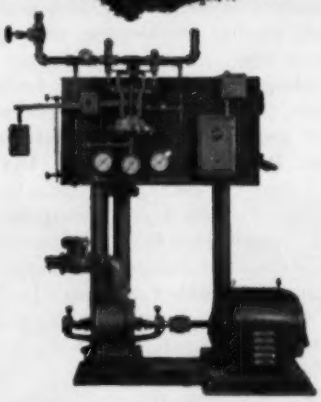
Awards

A N Hammer, metallurgist in quality control process laboratory of Convair, received the seventh annual Coolidge award for his report describing a method for inspecting swaged tubes by X-ray.

continued

Cut Steam Costs

with Stickle's differential drainage and boiler return system



A closed pumping system for returning condensation from heating and processing equipment under pressure directly to boiler at temperatures only 15 to 20 degrees lower than those at operating pressure. For plants using steam pressures between 50 and 250 lbs. Cuts the cost of steam these eight ways:

1. Cuts fuel costs 10% to 25% by completely salvaging condensate and returning to boiler at 300 degrees or higher.
2. Raises production with higher, more uniform boiler pressure, higher temperature steam.
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6. Cuts power used for pumping up to 75%, since system requires only 25 lbs.
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For more facts circle 334 on Reader Service card, p 117

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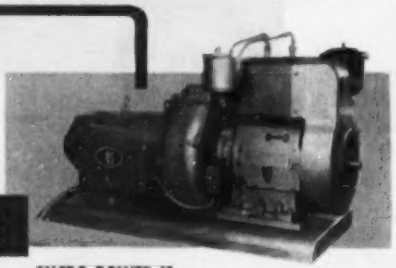
assures effectiveness of its protective boiler flame controls with...

MICRO POWER



In plants like Douglas Aircraft Company, Inc., in Tulsa, Oklahoma, where a continual supply of steam is vital to production processes, every precaution must be taken to assure against the hazards of boiler flame-out. To safely regulate its burners in the event of flame-out, the company utilizes highly sensitive electric controls. Since these flame failure controls *are* electric and must depend on a constant, unwavering power supply for successful operation, this is achieved with MICRO POWER.

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- for refinery and chemical process indication and control.
- by public utilities through microwave for protective relaying, telemetering and load distribution.

MICRO POWER PROVIDES...

- a constant uninterrupted source of electric power.
- voltage and frequency at usable value during transfers between motor and engine.
- stable voltage output.
- flywheel starting — no storage batteries.
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For complete information on this and other Micro Power applications, write...

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For more facts circle 335 on Reader Service card, p 117

Appointments

James F Fairman

Consolidated Edison Company Senior vice-president, James F Fairman, has been awarded the 1959 Edison Medal by the American Institute of Electrical Engineers. Presentation is scheduled for the organization's Winter General Meeting early this month.

Award honors Mr Fairman's performance in improving design of large electric-power systems, his leadership in atomic-power development and efforts to improve the engineering profession. He is a past-president and honorary member of AIEE.

Fairman received a BS degree from the University of Michigan in 1918. After receiving a MS degree from Michigan in 1921 he became an assistant professor in the College of Engineering. He later joined Brooklyn Edison Company which became a subsidiary of Consolidated Edison Company and in 1957 was named senior vice-president. He received the Distinguished Service Award of the U.S. Dept of the Interior in 1952.

R J Linney, executive vice-president of Reserve Mining Company, was awarded the Lawrence Saunders Gold Medal of The American Institute of Mining, Metallurgical and Petroleum Engineers for his leadership in the mining of taconite iron ore.

W R Marshall Jr received the 1959 Professional Progress Award of the American Institute of Chemical Engineers for his outstanding progress in the field of chemical engineering. He is professor of chemical engineering and associate dean of the University of Wisconsin College of Engineering and associate director of Wisconsin's Engineering Experiment Station.

R Reid Jr has been named official American delegate for drafting international standards for industrial belts and pulleys at the Fifth Plenary Session of the Organisation Internationale de Normalisation. He is assistant to the president of the R J Dick Company, Inc.

Begins on page 184

Institute elections

Willard C Brown

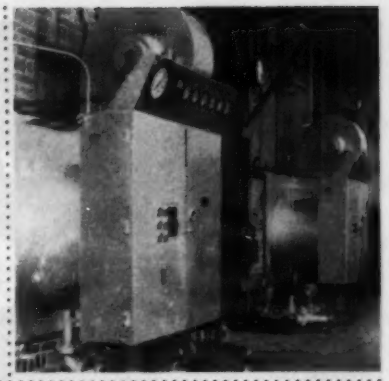
The U.S. National Committee of the International Commission on Illumination's new president is Willard C Brown, manager of lighting education for Large Lamp Dept of General Electric Company. He will head the committee for a term of four years.

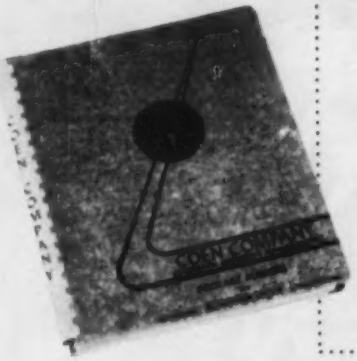
Internationally known for his work in illuminating engineering, he is now responsible for operation of the Lighting Institute at Nela Park. He was vice-president of the U.S. National Committee of the ICI for eight years and chairman of the American Standards Committee that produced the 1952 recommended industrial-lighting practice.

With his recent election he also becomes the U.S. delegate to the international lighting organization. Mr Brown holds electrical - engineering degrees from Virginia Military Institute, Massachusetts Institute of Technology and Harvard University.

Association of Edison Illuminating Companies: R G Rincliffe, president. **Atomic Industrial Forum:** R M Casper, L J Davenport, E H Wakefield—board of directors. **Cast Bronze Bearing Institute:** W H Crossman, president; C N Paden Jr,

CONSIDERING CONVERSION?





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The case histories of these applications . . . facts, figures and drawings . . . have been assembled in a book for each of our sales representatives. He would like to show it to you and apply the 47 years of experience it reflects to your problem. Chances are you'll find your application has already been engineered and you can save substantially on initial cost as well as enjoy reduced operating expenses in the years to come.

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Appointments

Begins on page 184

vice-president. **Electric Overhead Crane Institute, Inc:** W H Morgan, president; W W Peattie, vice-president. **Government Contract Management Association of America, Inc:** S Fried, president. **National Electrical Manufacturers Association:** N J MacDonald, president. **National Lubricating Grease Institute:** H A Mayor Jr, president; F R Hart, vice-president. Mayor Jr, president; F R Hart, vice-president.

Retirements

William M Bailey, formerly vice-president and chief engineer at Cornell-Dubilier Electric Corporation, has been retained as a consultant. He served the company for 28 years.

Dr Arthur E Brooks, assistant director of research and development for United States Rubber Company, after 30 years.

John A Dickinson, chief of the Codes and Safety Standards Section of the National Bureau of Standards, after 40 years of service.

R W Leutwiler, chief engineer at Illinois Engineering Company, after 46 years.

Cortis F Sherman, chief engineer of Magnetic Metals Company.

Obituaries

Hance H Cleland, retired chairman of the board of San Diego Gas & Electric Company, at the age of 75.

James L Hamilton Jr, Western Manager of Mead-Morrison Div, McKiernan Corporation.

William J Hutchinson, a director and former treasurer of The International Nickel Company, Inc and The International Nickel Company of Canada Limited, on November 25 at the age of 75.

Julian Nardi, chief mechanical engineer of Ford, Bacon & Davis, Inc, on October 30.

Frank J Trelease, retired senior consulting engineer with Ford, Bacon & Davis, Inc, on October 2 at the age of 72.

John Henry Zurn, vice-president of Zurn Industries, Inc on December 1 at the age of 34.

Bookshelf

Patents and Inventions—An information aid for inventors. *U.S. Dept of Commerce. 25 pp, soft covers, 15c—available from Supt of Documents, U.S. Govt Printing Office, Washington 25, D.C.*

Inventors and others concerned with technological developments will find useful info on patenting and patent procedures. Pamphlet helps you decide whether to apply for a patent, how to get patent protection, how to develop and market your invention.

Basic steps in patenting are summarized: make sure your invention is practical; witnesses, records and diligence; the search; studying patents found in the search; preparing the application; patent-office prosecution. A Q&A section covers fees, when to apply, ownership and sale of rights, plant and design patents, infringement and other typical problems.

Axial-Flow Compressors. *By J H Horlock, MA, University Lecturer in Engineering, Cambridge. 205 pp, 117 illust, $8.00. Butterworth & Co Ltd, 1367 Danforth Ave, Toronto 6, Ont.*

Fundamentals of fluid mechanics and thermodynamics as applicable to axial-compressor design are reviewed; book goes on to more-detailed studies of flows in compressors and cascades. Mechanical engineers with training up to graduate level in fluid mechanics and thermo should find it helpful.

Concepts, performance analysis and experimental work on 2-dimensional cascades, pitch-line design of compressor stages, 3-dimensional flow in stages, calculation of losses, stage efficiencies, stalled performance, testing and instrumentation, supersonic compressors are some topics covered. Appendix gives a preliminary design study of an axial-flow unit.

Primer of Lamps and Lighting. *By Willard Allphin. 224 pp, illust, $10.00. Chilton Co, Book Div, 56th and Chestnut St, Philadelphia 39, Pa.*

Basic info and material on lighting brings you up to date on lamps and

5 years of operation at the Possum Point Power Station of

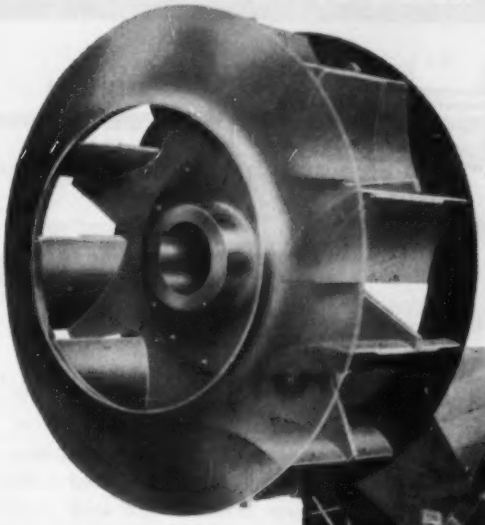
VIRGINIA ELECTRIC and POWER COMPANY

With Green RG Fans, of course.

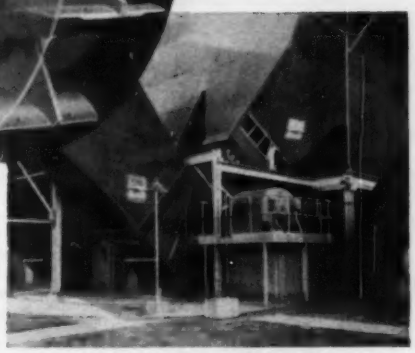
When Virginia Electric and Power Company planned their Possum Point Power Station, with Stone & Webster consulting, they selected Green RG Fans for both induced and forced draft.

Green RG Fans are rugged, reliable, self-cleaning and accessible.

When you want trouble-free fan performance — consult Green.



The Green RG is a centrifugal fan whose blades are forward curved and backwardly inclined with blade tips approaching a radius of the wheel. Design achieves a streamlined air passage with a minimum of turbulence.



This is the induced draft Green RG Fan installation at the Possum Point Power Station. ⅜" housing and inlet boxes. ½" scroll liners. Diamond checkered floor plate blade liners. Air-cooled, self-aligning sleeve bearings. 600 HP, 880 RPM motors.

Green

THE GREEN FUEL ECONOMIZER CO., INC.

BEACON 3, NEW YORK

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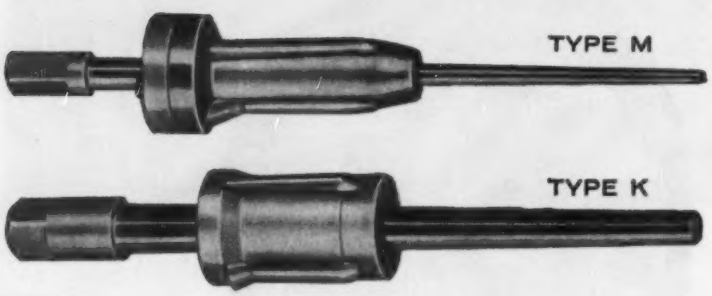
Boiler Tube Expanders
for tubes 3/4 in. I.D. and up



This 16-page bulletin describes general types of Elliott boiler tube expanders for fast, efficient tube rolling jobs. It also gives dimensions, prices and other descriptive data and shows various drum, header and short series mandrels which are used with Elliott boiler tube expanders. Drum mandrels are seen with Type M and Type K above.

Accessories available to adapt Elliott boiler tube expanders to various tube rolling applications include universal joints and extension shafts, sockets, gear drives, etc. A new heavy-duty, right-angle gear drive utilizes roller bearings to minimize friction, cutting down power losses.

RIGHT-ANGLE GEAR DRIVE▸
Available in ½, ¾ and 1-in. sizes

Write the Elliott Company, Lagonda Division, Springfield, Ohio, *today*, for your copy of Bulletin Y-46.

Y7-8

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Bookshelf

lighting layouts. The electrical contractor, maintenance superintendent and electrical foreman will be interested in down-to-earth info on correct uses of lighting and currently available lamps. Fluorescent-lamp and circuit data is included. One feature is a calculation slide rule, an aid in applying mathematics of the Lumen formula.

Nature and Properties of Engineering Materials. *By Z D Jastrzebski, prof of chemical engineering, Lafayette University. 571 pp, $11.00. John Wiley & Sons, Inc, 440 Fourth Ave, New York 16, N. Y.*

Chemistry and physics are linked to engineering practice by this book, with realistic applications kept in mind. Author approaches fundamental nature of materials from an engineering viewpoint, considering basic concepts of interatomic and intemolecular forces and their relationship to materials' structural characteristics.

Diffusion, crystallization, phase transformations and equilibria are discussed, principles developed in chapters on metals, ceramics.

Unified treatment stresses interrelationship among various properties and structures as well as effects of environments.

Niagara Power: From Joncaire to Moses. *By Cliff Spieler and Tom Hewitt, Niagara Falls Gazette. 80 illust, paperbound, $1.00. Niagara Power Publishers, Box 381, Lewiston, N. Y.*

Power potential of Niagara Falls is covered from the first 18th-Century sawmill through first mass ac production at a central powerhouse, to today's $702-million redevelopment, designed to make the Falls the largest hydro project in America.

Current project, one of the great construction challenges of the decade, takes up most of the book. Workers operating under rigid deadlines have reshaped the face of a community, relocating roads and utility lines, to keep the project on schedule.

Begins on page 195

Oil Hydraulic Power and Its Industrial Applications. *By Walter Ernst, Vice-President and Director of Engineering, Commonwealth Engineering Company of Ohio. Second Edition. 466 pages, 6 x 9, 350 illust. 29 tables. $12.50. McGraw-Hill Book Co, 330 W 42nd St, N. Y. C.*

How oil hydraulic power is generated, utilized, transmitted, controlled and applied in industry is clearly presented. Intended to give designers and engineers a well-rounded understanding of oil hydraulics, this second edition covers the field from basics of fluid mechanics, through component and circuit design, to latest information on commercial equipment and hints for operation and maintenance.

The author deals with all aspects of fluid mechanics as applied to oil under pressure: oil flow characteristics, viscosity and behavior in hydraulic machinery. Each stage of the hydraulic system is discussed, including the generation of oil hydraulic power by all types of rotary pumps, its use in rotary and reciprocating motors, its control by suitable valves and its transmission through piping, tubing, and fittings. How these components are coordinated into a useful working mechanism is fully covered.

In addition to updated facts and illustrations throughout, the book includes new material in areas such as petroleum-base and synthetic hydraulic fluids, hydrodynamic effects in rotating fluids, hydrostatic bearings, remote and closed-loop pump control, pump noise and vibration, transmission of hydraulic power, based on Joint Industry Conference Standards, directional valve design, gasket-mounted units, component standardization, servomechanism and servo valves.

Austria's 1959 electric-power production is expected to exceed 15 billion kwhr, a 1.5-billion kwhr gain over output recorded in 1958.

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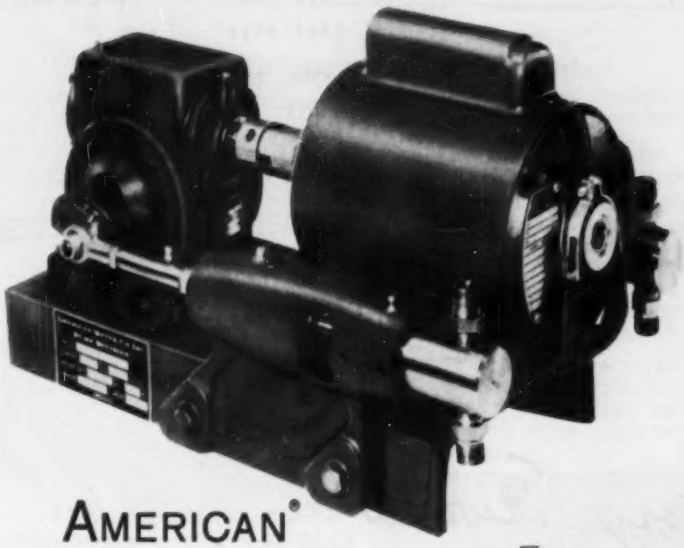

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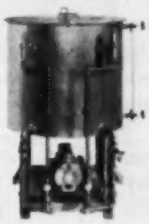
Series 100 pumps have repetitive metering accuracy of plus or minus 1% when operating between the limits of 10% and 100% of stroke length. Design simplicity assures dependable, economical water treatment. Screw adjustment on crank provides easy, accurate stroke regulation for capacities ranging from .65 gph to 13.10 gph at maximum pressure of 1000 psi on Series 100 Simplex model. Duplex models have double that capacity.

- interchangeable liquid ends
- spherical self-aligning bearings on crank and crosshead handle greater radial and axial thrust loads
- crossheads of hardened and ground steel ride on cast iron
- easily adjusted screwed packing glands
- heavy duty reducers
- NEMA frame motors
- nylon dust covers protect bearing surfaces



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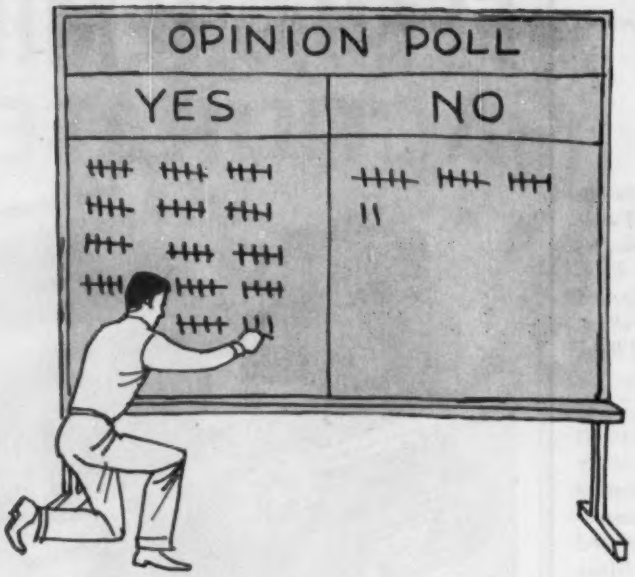


George Edwards

reminds: Great oaks grow from little acorns

Opinions I expressed in the December issue of POWER concerning standardizing operating-engineer examinations seem to have struck a responsive chord in a lot of people. Letters came from a cross section of the power-plant field, from fireman to consulting engineer. Big majority say they're in favor of the idea. Some admit that they, as individuals, aren't in a position to start the ball rolling but would help keep it moving in any way they could.

Others made specific suggestions as to how a standardized system might be set up. A few said they weren't against standardization, but didn't see why it's necessary. They asked what was the matter with things the way they are at present.

Some letters hinted that I didn't know what I was talking about, and that it really wasn't any of my business. This reminds me of the story about the deep-south preacher who was giving his congregation what-for on the evils of drinking, gambling and running around with wild women. As he exhorted them to stay clear of this "traffic with the devil," a little old lady in a back pew kept bobbing her head in emphatic agreement. "Amen," she'd say as best she could around a big lump of Copenhagen snoose tucked under her lip. "And the devil has tools to snare our womenfolk, too," the preacher thundered on, "such as gossipin' and dippin' snuff." At this, the old gal bridled. "Humph," she snorted, "now he's quit preachin' and took to meddlin' in other people's business."

Despite the dissenters I think that, slowly but surely, relatively uniform standards will come into effect for operating-engineer licensing. I think, too, that the majority of power-plant people, across the board, would like to see it come to pass.

Perhaps a move in this direction could start from what Pat Goggin advocates. Pat, who is chief engineer for Boiler Engineering and Supply Co, Inc, in Phoenixville, Pa., suggests that boiler manufacturers and insurance companies team up in a volunteer program of education for boiler operators. Appalled, as are many others, by statistics which show that preponderant cause of boiler failures is traceable to human failure, he says, "this represents a fertile area for intensive educational promotion." Pat has no axe to grind, one way or the other, so far as license requirements are concerned. His theme is education, which can't lead to anything but good for everyone concerned. And this would mean *uniform* education, fitting a man to handle a similar job no matter where.

In some areas excellent licensing standards exist which might be the basis for a uniform setup. Mightn't it be possible that a uniform educational program, such as Pat Goggin suggests, could be put in gear with a uniform examination and licensing arrangement? Such a setup might knock a big hole in power-plant equipment-failure statistics.

Radially laminated cores for single phase transformers

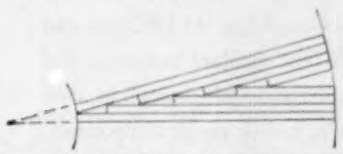
By E. H. Stauffer, Project Engineer, Brown Boveri Corp.

BROWN BOVERI

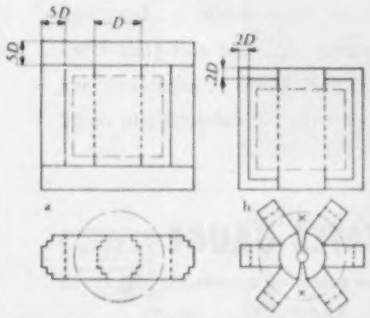
Brown Boveri's radially laminated cores allow the design of high-rating units with reduced height and weight and greater efficiency . . . to meet rail and highway limitations and to reduce costs.

Magnetic flux passes in and out of a transformer core through the edges of the core laminations. Thus, in a parallel laminated core, flux flows only in parallel planes. In a radially laminated core, flux enters from all directions — providing a number of advantages:

Reduced height.
Yoke height is reduced to about 20% of limb diameter. A large single-limb transformer with a 40" diameter radially laminated core, for example, will save up to 5 ft. of building height or shipping clearance as compared to conventional three-limb transformers.

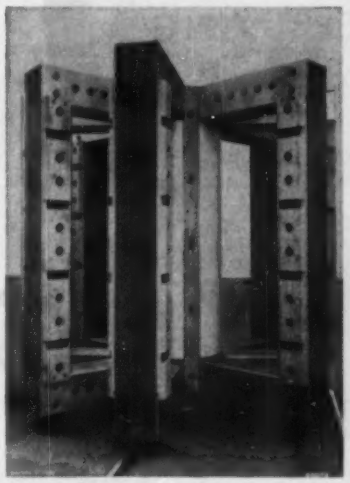


Sector of radially laminated core. Core space utilization is comparable to that of stepped parallel laminations.



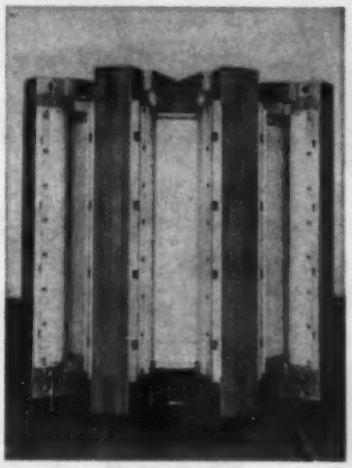
Height comparison for large single-phase transformers. a — parallel laminations. b — radial laminations. Empty sectors at x allow room for connections or taps to inner coils.

Lower losses.
All core laminations face edgewise to the concentrically arranged coils . . . reducing stray losses and eddy currents to a minimum.



Radially laminated core for single phase transformer, before winding.

Lower material costs.
The lower yoke height means considerably less iron is required. The lower, horizontal parts of the yokes also serve as coil supports so that elaborate bases are eliminated. The simple circular tank needs no wall reinforcements, uses a minimum amount of oil.

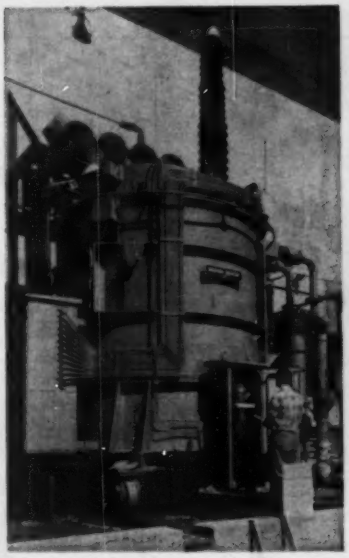


Radially laminated core for single phase transformer with winding in place.

Lower assembly costs.
Butt-jointing of yokes eliminates interleaving of yoke and core laminations, simplifies construction.

Other core construction features:
Special selection and preparation of core sheets and the use of non-magnetic or shielded pressure plates, bolts and screws reduce no-load current and iron losses. Yokes are tied rigidly to the central core with non-magnetic bolts for minimum noise level.

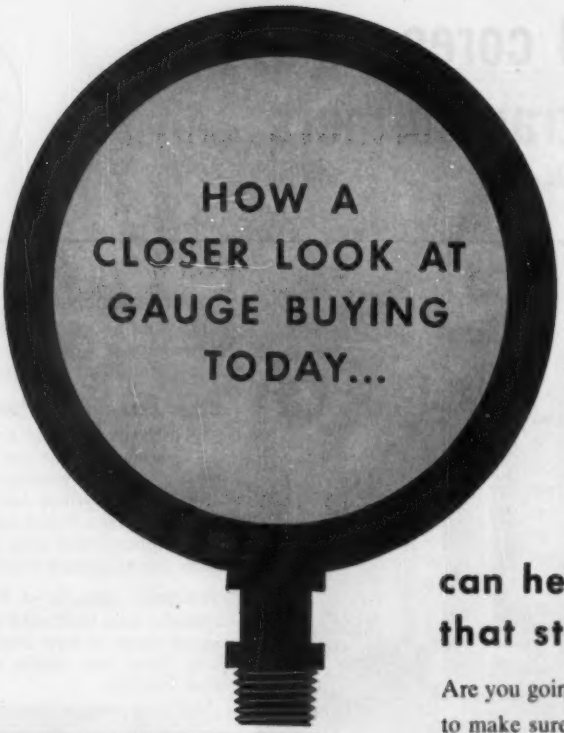
The total capacity of Brown Boveri transformers built with radially laminated cores is now over ten million kva. *None has shown any trace of iron troubles.*



One of 13 Brown Boveri single phase transformers with radially laminated cores at Robert Moses Dam, Massena, N. Y. All are 3-winding type, equipped with forced oil-water heat exchangers and rated 86,000 kva. Six are 115-13.2/13.2 kv, six are 230-13.2/13.2 kv. The spare is reconnectable for either voltage.

NOTE: Brown Boveri's "Splayed Flange Insulation" also reduces transformer size by reducing the distance between windings and the size of the core. This unique insulation is described in another advertisement.

BROWN BOVERI Brown Boveri Corp., Dept. P2, 19 Rector Street, New York 6, N. Y. Agents in 27 U. S. cities.



can help you pick gauges that stay on the job

Are you going to a higher price on gauges in order to make sure of gauge reliability? "Over-gauging" to get long life? It will pay to take a closer look at the size, flexibility, and high standards of accuracy of the United States Gauge line. At USG you can choose from over 50,000 standard indicating dial pressure gauges. Thousands of choices in case styles, sizes, materials, and in gauge components. Thousands of specials, too! Not only can you pinpoint your *reliability factor*, you can pinpoint your *price* for 99% of your gauge needs . . . from one line! It's easy to check . . . just call your USG distributor for your next gauge requirement. See the Yellow Pages, or write for catalogs and name of your distributor.

PICK exact Bourdon tube to meet stress, over-pressure, pressure range.

PICK Ni-Span "C" low pressure elements for exceptional thermal stability.

PICK Supergauge® for long life, accuracy to 0.5%.

PICK Solfrunt® for accuracy to 0.5%, solid-front safety from blow-outs.

PICK Test Gauges for dependability, and accuracy as high as 0.2 of 1%.

PICK Recorders and Recording Controllers built to stand vibration, pulsation.

PICK A-Line for premium reliability, accuracy to 1%, and savings up to 40%.

PICK Arc-Loc® Movement for longer life, easier and lower maintenance.

PICK U. S. Gauge Indicating Controllers or Transmitters for reliability.

USG **UNITED STATES GAUGE**
Division of American Machine & Metals, Inc., Sellersville, Pa.

Plant maintenance and management section

STEVE ELONKA
Associate Editor in Charge

Author C I Keene points out...

How to get the most for your insurance dollar

By C I KEENE, Vice-President—Engineering
Mutual Boiler and Machinery Insurance Co

Boiler and machinery insurance is a multiple-peril coverage. It provides protection against property damage and indirect losses, from boiler explosion or wreck of a steam turbine to the accidental burning out of an electrical winding or bearing. It's very flexible in the choice of specific coverages: you can get almost any degree of protection you want for your equipment.

If desired, boiler and machinery insurance in any one

plant may be limited to coverage against catastrophic losses. These losses might result from explosion of a pressure vessel. Or the coverage might be extended to include the failure of breakdown of equipment used for the generation, transmission, distribution and utilization of mechanical or electrical energy.

Reducing costs. Areas of boiler and machinery insurance in which costs can be reduced are limited unless you're willing to cut your coverage.

Insurance companies don't want to saddle industry with coverages that aren't needed. They try to provide an insurance program to fit the buyer's needs, considering hazards involved, potential size of any loss and company's financial status.

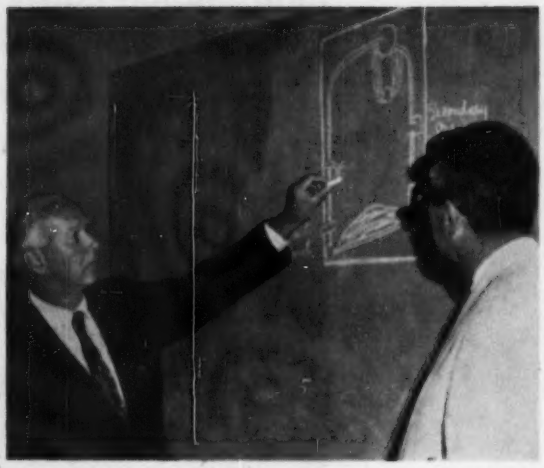
Here are some ways you can save on insurance and operating costs: (1) Make a careful risk analysis of your plant. This will reveal principal hazards and amount of loss that might be expected, including direct damage and indirect losses. Figure out how much you can afford to absorb before insurance pays remainder of loss—you may find you can carry some hazards presently insured against. Insurable values may have changed so that a reduced amount of insurance may be carried safely. Your insurance policies cannot remain static. They should be revised continually, based on times and conditions as they exist—exposures, insurable values and your financial situation.

(2) You can also reduce boiler and machinery insurance costs with deductibles. How? You may be able to absorb the first $1000 of any direct-damage loss. If so, you can purchase a policy with a $1000 direct-damage deductible. This saves you money. You may buy a contract with a $5000 use-and-occupancy deductible. Or you may absorb any use-and-occupancy loss for a given number of days by purchasing use-and-occupancy coverage with indemnity, starting at a specified midnight following an accident. Company then pays for all loss in excess of the deductible or following start of indemnity up to policy's limit for any one accident.

(3) You can also save on use-and-occupancy premiums if separate units or reserve capacities are provided, or where concentration of production capacity is avoided by multiple units instead of a single machine. For example, if two 5000-kw turbogenerators are installed to supply a 10,000-kw load, the use-and-occupancy premium would be less than if a single unit of 10,000-kw capacity were installed. Theory: there's less chance of a full production loss with two units each carrying half load.

(4) Another way to cut insurance costs is through good preventive maintenance and accident prevention. Insurance rates are based on industry loss experience. If losses increase over a long term, rates will ultimately increase. If you prevent accidents, improvement will be reflected eventually in lower premium rates.

You can make more immediate savings if you qualify



YOU CAN INSURE BOILERS against furnace explosions, loss of pressure-vessel contents, other perils, depending on your needs

One simple premium-trimmer: You take part of the risk

through a retrospective or premium-adjustment plan. Here the earned premium is adjusted according to loss experience during policy's term. If you prevent breakdowns and if ratio of losses to earned premium is less than established norm, premium is reduced. But if loss ratio exceeds this norm, policy premium increases.

(5) Finally, accident-prevention and inspection service of boiler and machinery insurance firms is based on their accumulated experience. This is an important factor in keeping costs down. Hundreds of engineers and inspectors check insured equipment and prevent accidents by study and elimination of causes.

Benefits of loss prevention are pretty hard to convert into dollars and cents, but there's evidence of its value from time to time. Our inspector, during a routine internal and audigage inspection, discovered a circumferential crack in the shell of a 12-ft-dia by 33-ft-long pulp digester. This crack ran nearly all the way around the vessel. If he hadn't caught it, a very serious accident would have occurred with estimated loss of $250,000 and possibly loss of life. Same engineer made a dismantled inspection of a 1250-kw steam turbine, found 37 cracks in the bladings. Damage to turbine as well as production loss would have resulted if cracks had gone undetected.

Basic policy, written for a term of three years or less, provides only for insurance against property loss from accident as defined to specified units or groups of objects. For example, a large motor may be insured or all motors with capacities in excess of a specified horsepower may be covered together as a group.

Policy agrees to pay for loss because of damage to: (1) property of the insured (2) property of others (3) certain expediting expenses incurred for repairs—an optional coverage (4) bodily injury for which the insured is liable, excepting any obligation under workmen's-compensation laws and any portion of loss covered by other insurance—optional coverage.

Insurance may cover furnace-gas explosion (very common today), loss of contents in a pressure vessel, contamination loss from a refrigerant or accidental cracking of machinery parts. Policy may also include "liability" for loss; the difference between actual cash value (after deductions for depreciation) of equipment or property damaged by an accident and the amount actually expended to repair or replace property in a condition equal to its condition when new (this is called *repair* or *replacement coverage*).

Indirect coverages such as: (1) use and occupancy (business-interruption insurance) (2) consequential damage (spoilage) (3) increased cost of operating less-efficient units because of breakdown of an insured unit (outage insurance) and (4) loss arising from total or partial loss of power, steam, gas, water or refrigeration caused by failure of public-utility equipment furnishing the service, (power-interruption insurance) may all be added to your policy by endorsements.

Most important of these coverages above basic direct-damage coverage is use and occupancy. This may be written on a fixed-value basis of a certain number of dollars per day for each day of production loss, or on actual-loss-sustained basis where premium and coverage are geared to production values. These vary from month to month in some plants.

Definitions of insured units are included in your basic policy. *Object* as applied to a boiler means the complete boiler or apparatus described in schedule. It also includes: (1) that part of apparatus under pressure within setting or furnace of boiler (2) any steel economizer used with complete boiler or apparatus (3) any indirect water heater used for hot-water-supply service, installed outside the boiler, that's directly in boiler-water circulation and doesn't form a part of a water-storage tank (4) any piping, including valves and pipe fittings, between parts of con plete boiler or apparatus (5) any piping containing steam or vapor, or condensate if piping is on premises of insured or between parts of premises (6) feedwater piping between boiler and its feed pumps or injectors (7) any pipe coil, used for heating buildings, utilizing steam or vapor from boiler (9) any valve or pipe fitting on the piping and (10) any separator or trap located on the piping.

The term *object* doesn't include cast-iron economizers (unless designated in schedule), other apparatus using steam or vapor, exhaust piping transmitting steam to atmosphere, deaerators, feedwater heaters, receiver-separators, accumulators or any other tank or vessel. Of course this equipment can be insured if desired.

Accidents are also defined in the basic policy. An *accident* to a steam turbine covered against breakdown means: (1) sudden and accidental breaking of the object, or any part thereof, into two or more separate parts—this does not include breaking of any gasket, rupture disk, fuse, brush or insulation, nor the loosening of any assembled parts (2) sudden and accidental loosening of any wheel, disk, blade ring, drum or dummy piston on the spindle, rotor or shaft within the driving turbine—but not loosening of blades, buckets or vanes, shroud rings or other assembled parts (3) sudden accidental burning out of object or any part, but not burning out of fuses or brushes, or of insulation unless accompanied by a short circuit (4) accidental deforming of any rotating part not caused by cracking—this doesn't include deforming of blades, buckets or vanes, shroud rings or other fastenings, electrical conductors or their insulation or of band wires, wedges or their fastenings.

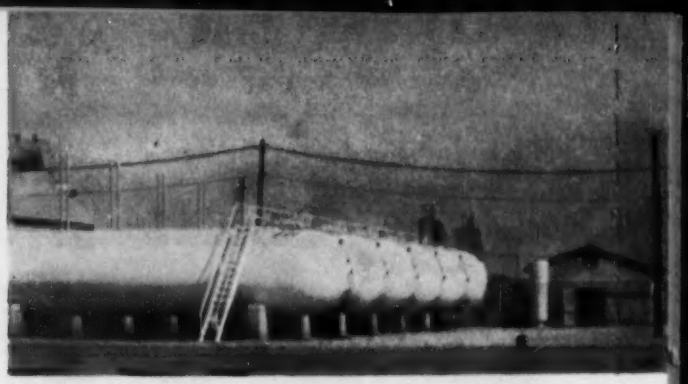
Nuclear coverage. Boiler and machinery objects in nuclear-power plants are insured under all-risk property-damage policies. These are then reinsured in nuclear-insurance pools of stock and mutual-insurance companies. Coverage, method of rating and inspection service are similar to conventional coverage.

Determining premium rates for boiler and machinery insurance is somewhat involved. Direct-damage premium charges are based on individual object sizes and capacities or actual cash values of individual objects or groups. Another base is coverage limit you want per accident. One possible example is the rate for watertube boilers: it's based mostly on their operating pressure and the heating surface.

Use-and-occupancy premiums are based on type and size of equipment, daily production values, period of indemnity, limit of loss and time when indemnity is to begin. For example, you may request use-and-occupancy insurance to cover two steam turbogenerators with a loss limit of $400,000 and a daily indemnity of $4000. This will give you coverage for 100 days at $4000 per day against full production loss or a proportionate amount of daily indemnity for a partial production loss until the $400,000 is exhausted.

. Unfortunately it's the failures and not successes in preventing accidents that make news. Loss-prevention activities cost several million dollars, but they're economically justified because loss prevention and cost reduction go hand in hand. Unless good preventive maintenance keeps up equipment and cuts accidents, your manufacturing costs are almost sure to increase.

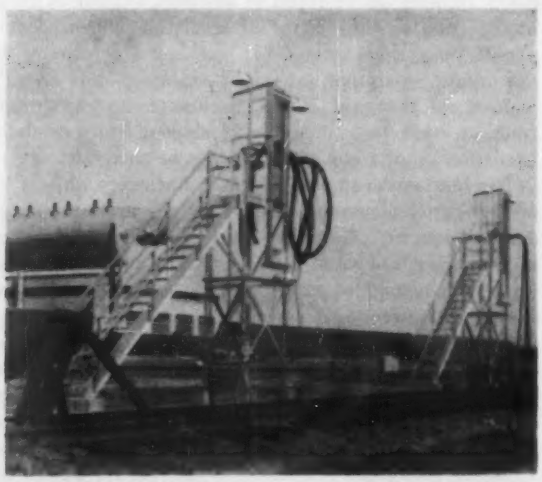
If you'd like more complete information, a 25-p booklet, *Outline of Boiler and Machinery Insurance*, is yours for the asking. Write to Mutual Boiler and Machinery Insurance Company, Boston, Mass.



PROPANE-STORAGE tanks' capacity provides for 24-hr per day opera-

Glass-plant setup cuts trouble potential because...

Propane-air backs up base fuel

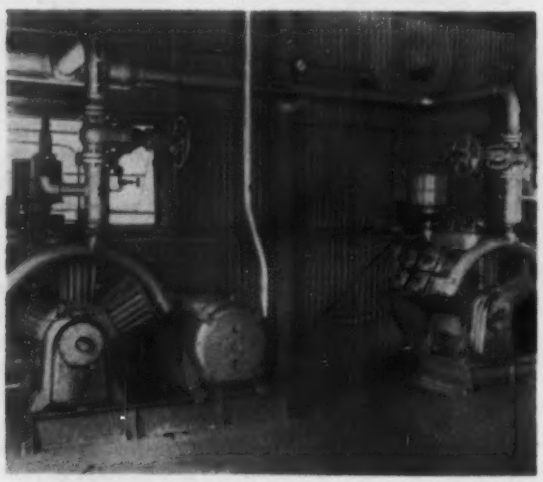


PROPANE-UNLOADING towers, complete with cantilever platforms, are set up for simultaneous transfer from two tank cars

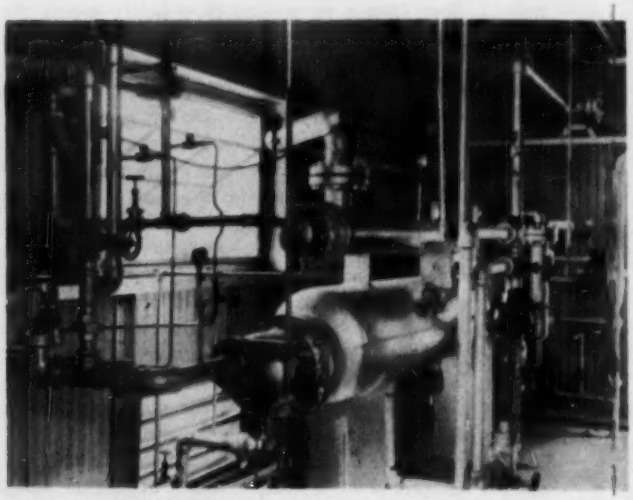
Pinpoint temperature control of process is a must in many industries—it's vital in glass manufacturing. Here, tanks used to melt silica and other ingredients require closely controlled temperature over continued life of the tank. Any accidental temperature loss can be rough, meaning a complete tear-down and rebuild job on furnace or tank. Obviously this is a costly business, both in operational expense and production loss.

Fuel failure, which invariably means temperature loss, poses this sort of threat. Something must be done to forestall it. A standby fuel supply is the first answer that springs to mind, but this is easier said than done —at least on an economically feasible basis. However, we've accomplished this at our new plant at Shelby, N. C.

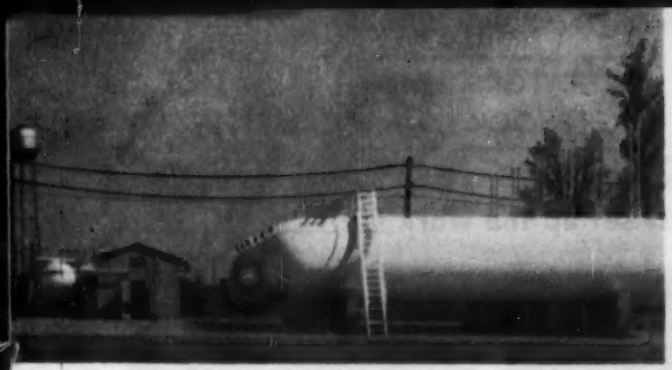
To provide "insurance" against natural-gas curtailment or failure, we decided to put in a completely automatic LP-gas standby system. Our engineers, working with Lockwood Greene Co, engineers and designers, and



AIR COMPRESSORS, 100-hp each with total capacity of 1082 cfm, operate loaded or unloaded, singly or together as ordered by signals



STEAM VAPORIZER, 2000 gph, is completely automatic, has steam and superheat temperature control plus fail-safe shutdown devices



tion for six days. Buildings, *center*, houses equipment and controls

By G B ZURHEIDE, Chief Staff Engineer
Fiber Glass Div, Pittsburgh Plate Glass Co

Drake & Townsend, Inc, propane-plant engineers and erectors, came up with a system that we believe is unique in this country and one which may help other companies faced with a similar problem. System is designed so that a slight drop in natural-gas-supply pressure turns on the high-pressure LP-gas-air plant immediately and automatically with no manual or supervisory aid.

Original specs drawn up by our engineering department called for a 1350-Btu propane-air supply with a distribution-system pressure of 25 to 30 psi. Further, our engineers wanted (1) a 100%-automatic system to supply fuel if natural-gas pressure drops below 30 psi and (2) a turndown range of 3 to 100% of load conditions.

With general conditions specified, prime problem was how to get immediate supply of required-Btu gas when natural-gas pressure failed. To get this and to give the Btu controller enough time to set up proper mix, we installed a 1500-cu-ft mixed-gas surge tank. This plus pipeline's capacity allowed for Btu-control-system time lag and gave us minimum turndown-range requirement.

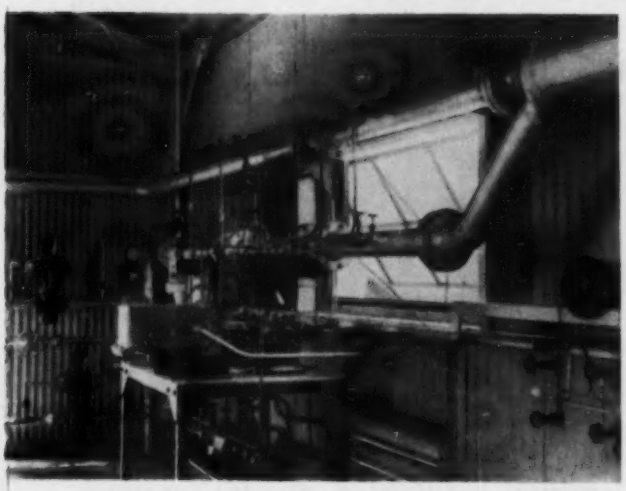
Basic equipment upstream of surge tank and control: (1) Twelve 30,000-gal propane tanks (2) two high-level tank-car unloading racks (3) steam vaporizer with low-temperature control and alarm (4) two air compressors for gas-mixing-system supply and (5) Btu control system plus continuous gas or propane-air sampling.

System is designed for operation in this sequence: (1) Natural-gas pressure drop to 27 psig causes signal to control panel which starts No. 1 air compressor in unload condition. (2) Further pressure drop to 27 psi allows mixed-gas (propane-air) valve to open, start flow of 30-psi mix through distribution piping. (3) When surge-tank pressure drops to 25 psi, Btu control automatically samples mix coming to surge tank, at same time stops sampling at natural-gas supply line. With proper mix established, Btu control maintains constant value. (4) When air-receiver pressure drops to 47 psi, already-running unloaded compressor goes to work. If it can't supply demand it's backed up by No. 2 compressor as soon as receiver pressure drops to 45 psi.

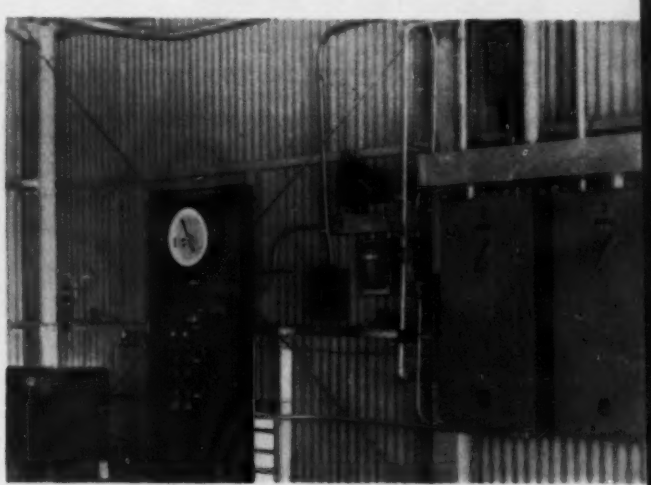
By this time the system has been automatically turned on and is feeding the required propane-air mix to plant distribution system. This continues until natural-gas supply is restored. Then system goes back to normal: (1) When air-receiver pressure climbs to 48 psi, No. 2 compressor unloads but continues running. A 1-psi increase stops No. 2 and unloads No. 1 compressor. (2) When natural-gas pressure reaches 30 psi, No. 1 compressor stops, air and propane-vapor valves close. Next, sampling system transfers itself from propane-air back to natural-gas supply line without manual assistance.

Air and electric shutoff devices protect the system if air or power supply fails. In this event system closes, but with restoration of air or power it becomes operative automatically.

Plant's propane-storage capacity is sufficient to maintrain around-the-clock operation for at least six days.



MIXING SYSTEM moves properly proportioned propane and air into plant distribution piping. Capacity is 115,000 cfh at 30 psi

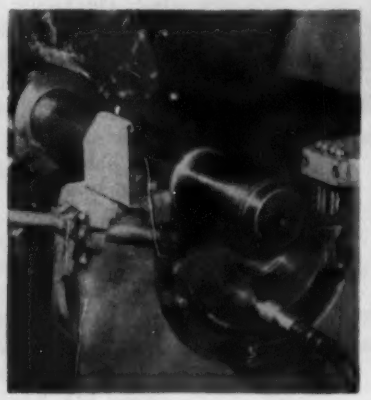


BTU CONTROL provides for continuous sampling of natural gas or propane-air mix, maintains heat value under varying flow

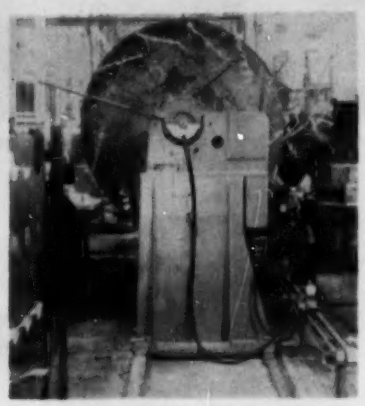
OPERATORS' NOTEBOOK **136**

Let's

First: we must set up the work



1 Put in correct supporting bearing to fit arbor installed in bore of the wheel

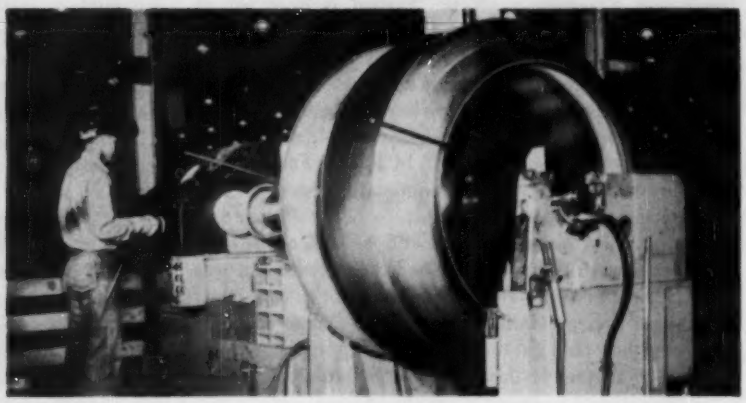


2 Connect pressure oil fitting to bearing, lower fan wheel and supporting arbor

3 Supporting pedestals are I-beam mounted, imbedded in concrete, very rigid

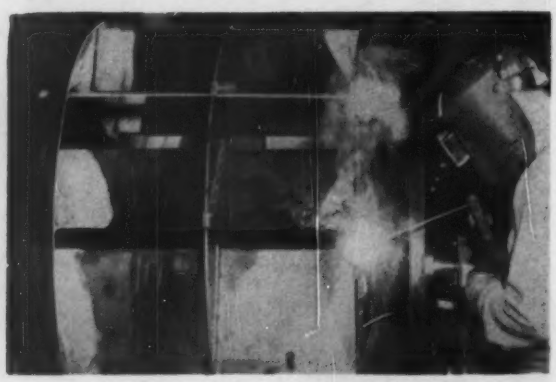
Second: here's how we do the balancing

7 Now attach drive coupling to end of the arbor and then start your machine



8 Flip angle-indicating rods into position to provide easy angular reference for welding correction. Start rotating the wheel, then locate angle and read the unbalance

Third: now we add the needed weight

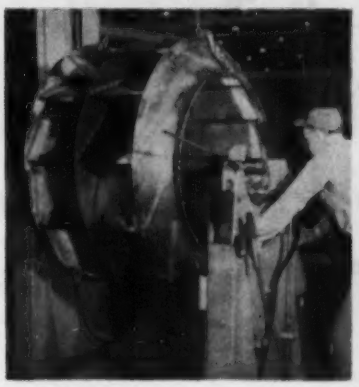


11 Find angular location and weight needed for each correction plane, then stop machine. Weld the weights into position

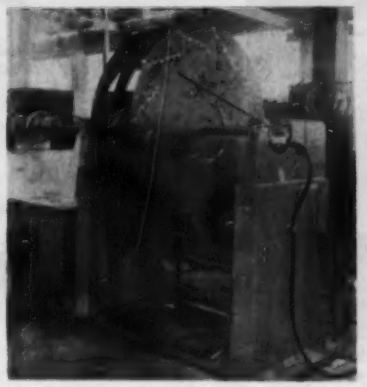
12 Wheel is now balanced by these two welded correction plates. Total time needed to balance this fan wheel was 1 hr 45 min

dynamically balance your fan wheel

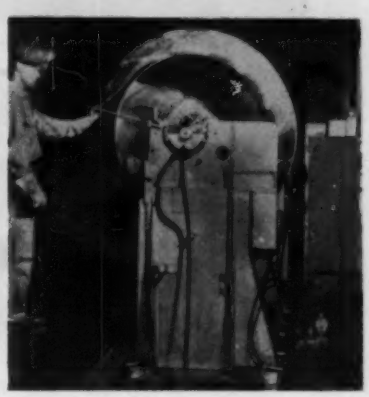
By STEVE ELONKA, Associate Editor



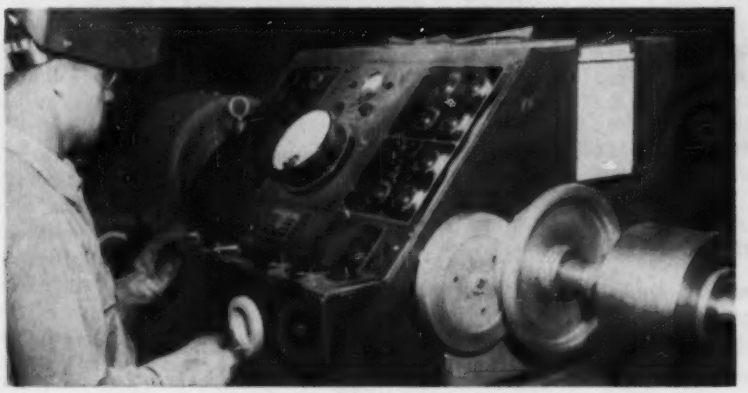
4 Adjust right-hand pedestal work support for maximum 1/64-in. bearing play



5 When the pedestal's in position, lock in place with hand locks at the base



6 With fan wheel set up and pedestal adjusted, wheel is ready for connection



9 Locate correct angle by turning a simple handwheel until reading on amount meter at center of balancer panel is *null*. Exact angle of unbalance is shown for each plane

10 Measure and record unbalance. Dial shows ounces needed in each plane

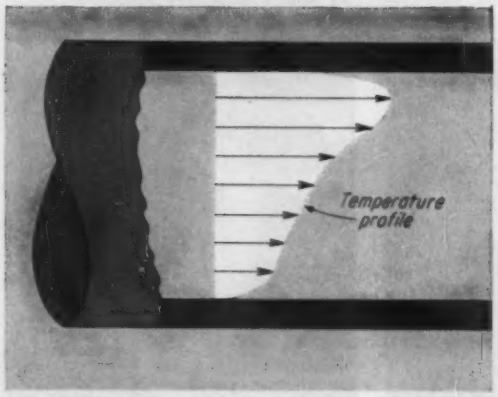
Here's general balancing info

Dynamically balancing your rotating equipment reduces noise and bearing wear caused by vibration (see POWER's 24-p special report, *Balancing*, June 1959). Proper balancing is a must, especially for blower-fan wheels. Photos show how The Trane Co uses a Gisholt balancer on new wheels.

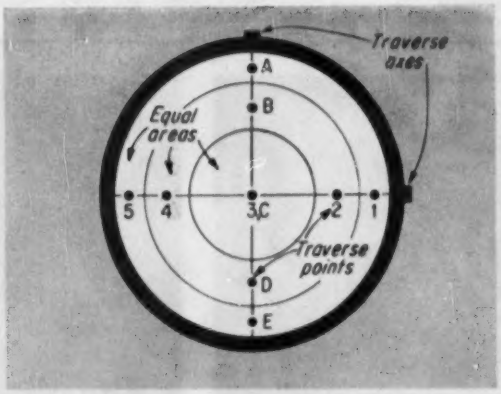
Balancing distributes the mass in a rotor. You must make mass or weight alterations in each of two planes perpendicular to the axis for static and dynamic balance. Balancer shown indicates amount of alteration or correction the rotor will need, plus angular location of unbalance in two correction planes. Unbalance is found here electrically.

To balance, turn handwheel until reading on amount meter (center of panel) is *null*. Wheel is interconnected with protractor wheel at right side of balancer headstock panel. So exact angle of unbalance is indicated on protractor for each correction plane. As part rotates, flip left or right correction switch with left hand, note meter reading and turn corresponding dial on right side of headstock until meter reads *null*. This dial duplicates meter reading and shows number of ounces needed in each corrosion plane. Having found the angular location and amount of unbalance, just add or remove weight until your wheel is balanced.

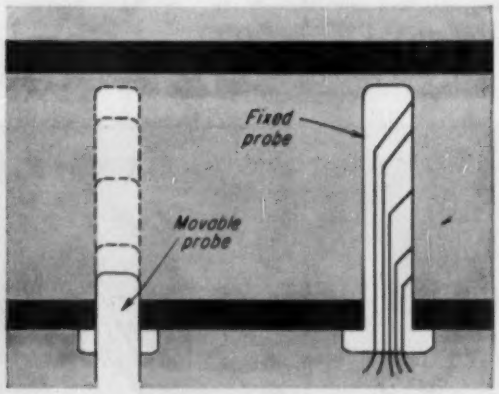
PERFORMANCE
TESTING NO. 3



TEMPERATURE UNBALANCE may occur in steam and water lines to and from heaters, particularly with low loads



TRAVERSE METHOD obtains temperature readings from two directions at points in equal areas of pipe cross section



TRAVERSE PROBES may be fixed or retractable, but for most high-pressure lines retractable probes aren't practical

Impossible heater temperatures?

Check temperature stratification

When feedwater-heater measurements of Btu input won't balance output, this testing trick may solve your problem

By L E STEWART, Associate Editor

POWER's performance-testing series covered heat exchangers in Part 2 (Nov 1959, p 198). We pointed to the importance of accurate temperature measurements when attempting heat balances of equipment; covered basic techniques involved in use of bucking thermocouples, etc for precise measurement of fluid temperatures. In isolated cases, accuracy of the primary measuring element is not the stumbling block. In most testing work, performance engineers must assume that stream temperatures are reasonably uniform, and feedwater heaters are no exception since design velocities are well into the turbulent range. But under certain circumstances the temperature profile across steam or water lines is nonuniform; single reading is useless.

Low-load operation may create a testing problem. Many engineers have run into the discouraging case of impossible temperatures for closed heaters. Heater-drain temperatures below feedwater-inlet temperature usually are blamed on inaccurate thermocouples. This would be the first item to watch, but what do you do when everything humanly possible has been checked to guarantee element accuracy, and readings are still off? Final possibility is location of element at a point not representative of average conditions.

Temperature stratification of the sort illustrated, above left, is possible, particularly at the lower loads. A conventional thermowell would not supply representative readings, so if a better reading cannot be obtained at some other point in the line a multipoint traverse may be the answer. This traverse should be made along pipe diameter at points which represent centers of equal areas of the pipe. Top accuracy dictates traverses at 90-deg intervals, top right.

Probe construction is dependent on traversing method used. Where possible, install fixed probes in place of thermowells — lower sketch indicates general idea. In fixed design, shielded thermocouples set in the grooved surface of solid bar stock supply traverse readings. Welding thin tubing over probe forms seal.

Low-pressure systems may be able to use traveling probes inserted through packing glands. But normally, sealing problems with this type of probe sharply limit its usefulness.

How much will continuous blowdown add to chemical cost?

By W F DEVENNEY, Consulting Engineer, Springfield, Pa.

Moderate-pressure industrial steam plants are frequently operated with a high percentage of makeup and no external water conditioning. Occasionally one of these plants, using slug feed of chemicals and intermittent blowdown, decides to install continuous blowdown. Advantages of continuous blowdown are well known, but combination of continuous blowdown with slug feeding of chemicals will produce the disadvantage of increased chemical cost. This drawback must be taken into account if you're planning a shift to continuous blowdown and chemicals are still to be slug fed.

With slug feed, sufficient chemicals must be introduced to provide for interval elapsing before you feed in the next slug. Therefore, a high concentration of chemicals will be lost through continuous blowdown immediately after shot of chemicals is added to the boiler. Amount of unreacted chemicals lost decreases as time interval elapses, reaching a minimum just before you introduce the next slug of chemicals.

In the table, n is number of slugs of chemicals fed daily. Obtain k by dividing gallons of blowdown per hr by gallons of water contained in boiler at normal drum level. Factor obtained from the tables using appropriate n and k values is multiplied by chemical consumption with slug feed and intermittent blowdown. Resultant value is your chemical consumption with continuous blowdown and slug feeding.

Increase applies to any internal-treatment chemical that does not volatilize with the steam and return with the condensate. You can compare this cost increase with the cost of installing continuous chemical feed to determine whether continuous feed is economically justified when changing to continuous blowdown.

Offsetting increased cost of chemicals is the value of heat recovered from continuous-blowdown water. It's possible that frequency of slugs per day could be made great enough so increased chemical cost is entirely offset by value of the heat recovered. But labor costs and inconveniences associated with an increased number of slugs might make this alternative undesirable.

Take the case of a boiler producing 20,000 lb of steam per hr. Using a 5% blowdown rate, hourly blowdown will be 1053 lb. Internal boiler-water treatment uses a blended compound costing $0.20 per lb; 25 lb per day are used with slug feed and intermittent blowdown at a daily cost of $5.00. If boiler holds 5000 lb of water, k is 1053/5000 = 0.21. With continuous blowdown and three slugs per day, factor 2.600 will be found in the table on line k = 0.21 in column n = 3. $5.00 × 2.60 = $13.00, the daily treatment cost under these conditions. This is an increase of $8.00 per day. Similarly, if six slugs are used per day, f factor is 1.567 (k = 0.21; n = 6). Daily cost for treatment is then 1.567 × $5.00 = $7.85; an increase of only $2.85.

Chemical-use factors

K	n=24	n=12	n=8	n=6	n=4	n=3	n=2	n=1
0.01	1.010	1.010	1.017	1.020	1.030	1.041	1.063	1.130
0.02	1.010	1.020	1.030	1.041	1.063	1.086	1.130	1.284
0.03	1.017	1.030	1.047	1.063	1.096	1.130	1.204	1.464
0.04	1.020	1.041	1.063	1.086	1.130	1.178	1.284	1.679
0.05	1.026	1.052	1.079	1.107	1.166	1.230	1.371	1.933
0.06	1.030	1.063	1.096	1.130	1.204	1.284	1.464	2.237
0.07	1.036	1.072	1.113	1.154	1.243	1.341	1.564	2.600
0.08	1.041	1.086	1.130	1.178	1.284	1.401	1.679	3.030
0.09	1.047	1.096	1.148	1.204	1.326	1.464	1.801	3.540
0.10	1.052	1.107	1.166	1.230	1.371	1.532	1.933	4.180
0.11	1.057	1.119	1.185	1.256	1.416	1.603	2.078	4.930
0.12	1.063	1.130	1.204	1.284	1.464	1.679	2.237	5.840
0.13	1.068	1.142	1.223	1.315	1.516	1.759	2.416	6.940
0.14	1.072	1.154	1.243	1.341	1.567	1.848	2.600	8.270
0.15	1.079	1.166	1.263	1.371	1.622	1.933	2.800	9.880
0.16	1.086	1.178	1.284	1.401	1.679	2.029	3.030	11.900
0.17	1.090	1.191	1.304	1.432	1.738	2.130	3.280	14.200
0.18	1.096	1.204	1.326	1.464	1.801	2.237	3.540	17.200
0.19	1.101	1.217	1.348	1.498	1.865	2.343	3.850	20.700
0.20	1.107	1.230	1.371	1.532	1.933	2.470	4.180	25.100
0.21	1.113	1.243	1.393	1.567	2.004	2.600	4.540	30.800
0.22	1.119	1.256	1.416	1.603	2.078	2.740	4.930	37.100
0.23	1.124	1.270	1.440	1.641	2.156	2.880	5.360	45.300
0.24	1.130	1.284	1.464	1.679	2.237	3.030	5.840	55.400
0.25	1.136	1.297	1.489	1.718	2.321	3.200	6.360	66.700
0.26	1.142	1.315	1.516	1.759	2.416	3.370	6.940	82.200
0.27	1.148	1.326	1.541	1.801	2.500	3.540	7.570	99.500
0.28	1.154	1.341	1.567	1.848	2.600	3.750	8.270	123.000
0.29	1.160	1.355	1.594	1.888	2.700	3.960	9.040	150.000
0.30	1.166	1.371	1.622	1.933	2.800	4.180	9.880	183.000

USE THESE FACTORS to calculate increased chemical consumption with continuous blowdown if you retain slug feeding

Plant

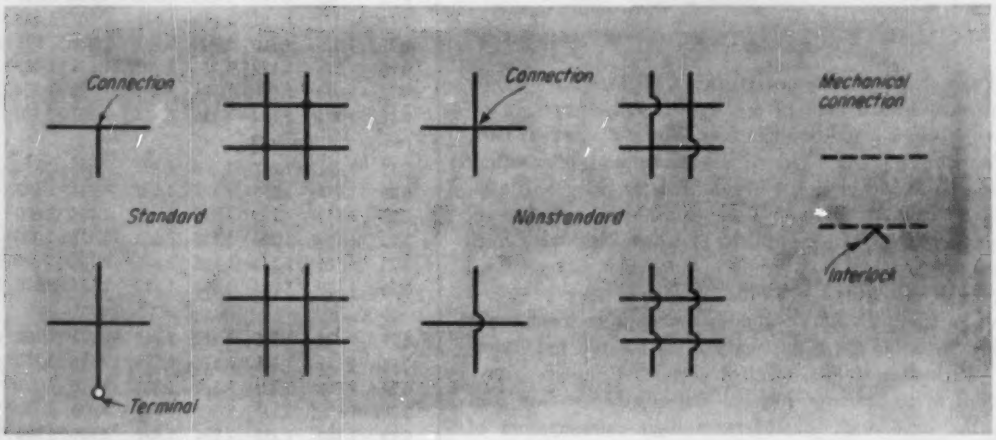
Electrical Fact File

Need a brushup on standard drafting symbols ?

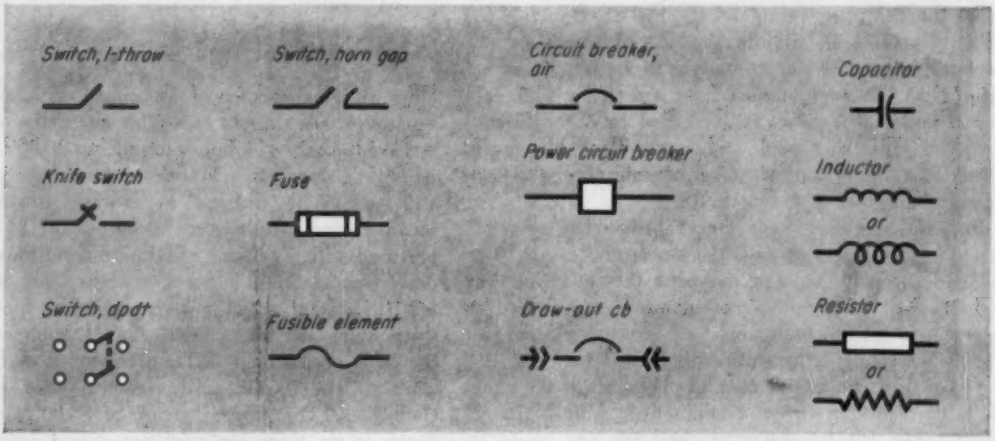
NO. 44:
STANDARD SYMBOLS

By NORMAN PEACH, Associate Editor

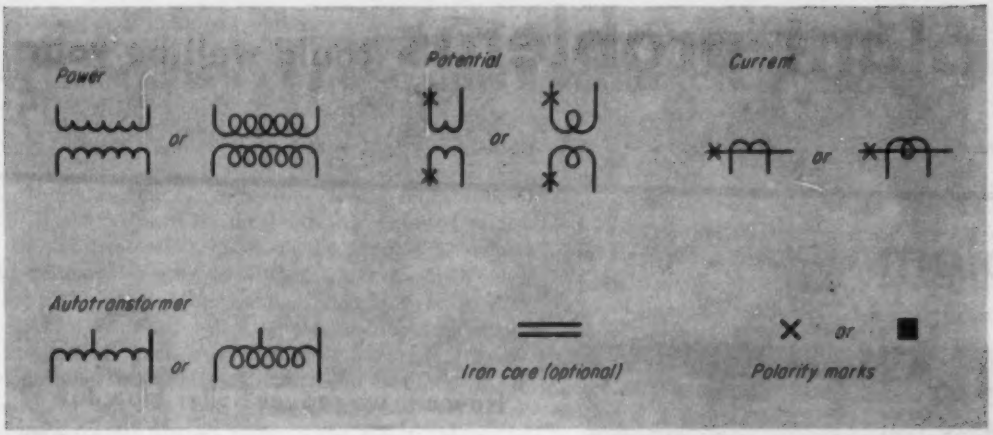
Most electrical drawings you'll meet today use symbols standardized by the American Standards Association and explained in its publication *ASA Y32.2—1954*. You can get a copy from the ASA, at 70 East 45th St, New York 17, N. Y. The most commonly used power and industrial symbols are shown in these pages. Several of these symbols aren't complete without a letter or number to show their particular function.



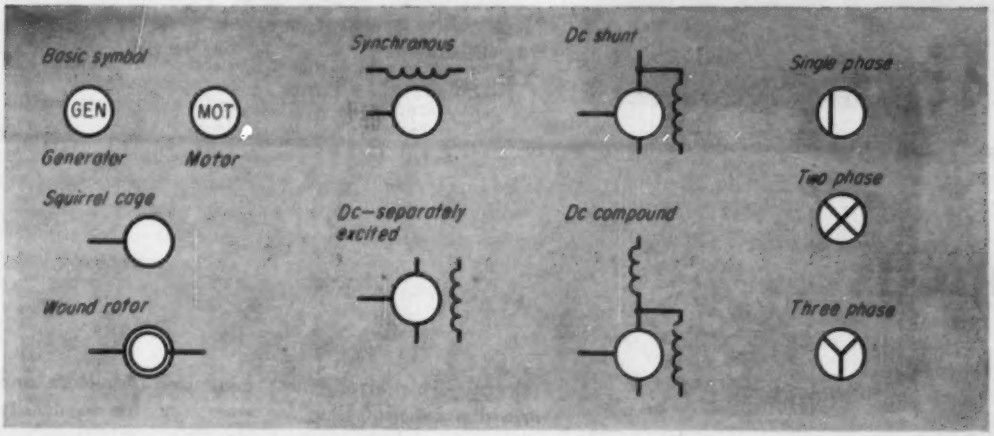
CONDUCTORS in standard drawings are straight lines. Connections are indicated by a dot. Terminals are small circles. Older, nonstandard drawings may or may not use a dot to indicate connection



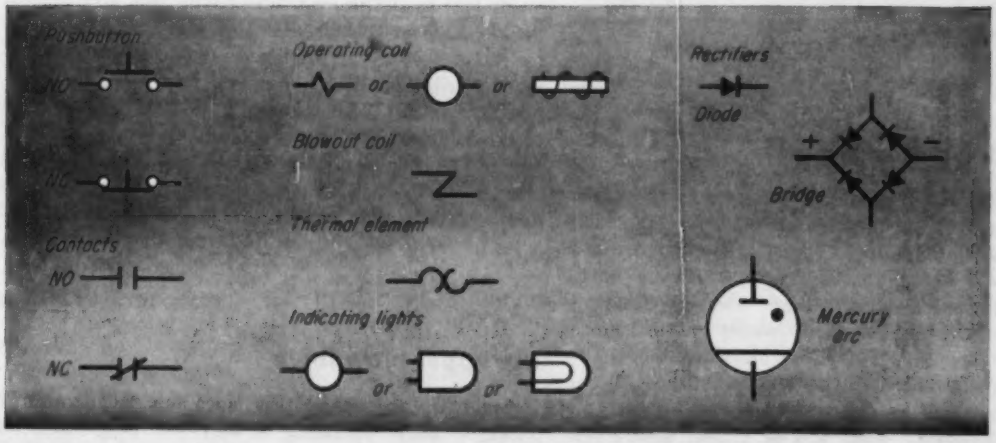
DISTRIBUTION and protective gear requires many symbols. Air-breaker symbol may be used as general sign. Power-breaker symbol needs no identification on power diagrams; otherwise mark *CB*



TRANSFORMERS can be represented in two ways. Use iron-core symbol if there's a chance of confusion with air-core transformer. Dots aren't used for polarity of potential and current transformers



MOTORS AND GENERATORS are variations on these symbols; 1-line diagrams are shown. Additional lines connect to same symbol when used. Ac machines may be shown by winding symbols



CONTROL and other apparatus can be shown in detail. Each control device has a number or abbreviation placed next to it to indicate its function. Indicating lights, meters have letter inside circle

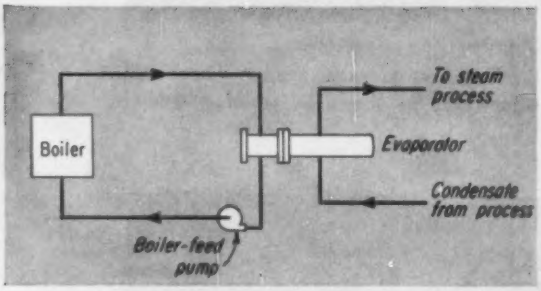
These **plant problems** could well be yours...

Problem...

How can we reduce boiler blowdown?

We operate an oil-fired packaged boiler rated at 23,000 lb per hr at 150 psig. Condensate returns are from a variety of industrial sources and badly contaminated. They differ widely in both quantity and quality. Required heavy chemical feed and resultant high boiler-sludge concentrations produce intermittent blowdown of about 8%. Only 4% would be sufficient to control dissolved solids. Is there an inexpensive way to control this sludge and reduce blowdown? —*JSV, November* POWER

Solutions...



Close boiler-water cycle

Continuous blowdown usually is preferred for packaged boilers, particularly in installations having a high rate. This permits more uniform operation and allows less dependence on bottom blows. Since continuous-blowdown connection, feedwater and chemical-treatment inlets are usually on the drum, watch out for short-circuiting of chemicals directly to blowdown.

JSV does not indicate type and quantities of contaminants contained by the condensate, but one method of removal would be some sort of gravity separation. Success of this design is dependent on having the condensate pass through a long flow path at a very low velocity. This arrangement minimizes turbulence and provides sufficient time for separation due to density differences of the respective fluids.

An alternate means of overcoming the problem employs a "heat-transformer evaporator," left. This hookup allows steam from the boiler to pass through shell-and-tube heat exchanger. Steam condenses, transferring latent heat to the process fluid. With this arrangement the boiler steam-condensate circuit does not contact process fluids, thereby preventing contamination and reducing boiler-blowdown requirements to reasonable levels.

Although this scheme usually involves greater first cost, available operating economics may justify its installation. *JSV* should prepare an estimate comparing fixed charges for this facility with resulting savings from reduced consumption of water-treatment chemicals.

H B WAYNE, *Woodhaven, N. Y.*

Use upper blowdown

I would like to suggest that since this is an oil-fired packaged boiler operating at only 150 psig, *JSV* can most probably achieve a considerable reduction by two methods: reduction in direct heat loss by use of continu-

...Here's how Power readers would tackle them

LAWSON STEWART, Associate Editor

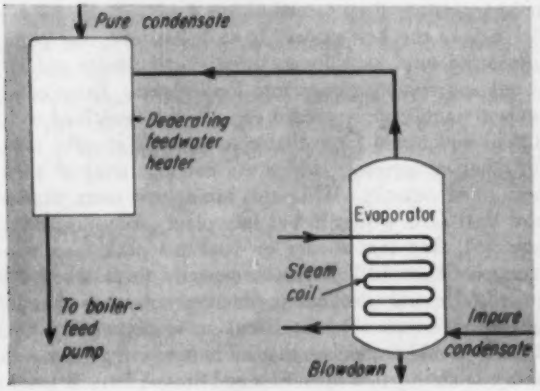
ous blowdown, and use of heat-recovery equipment. Control should be based on the control of dissolved solids.

In addition to this, it should be possible to reduce intermittent blowdown to a point where it will remove only high boiler-sludge concentration, providing that control of dissolved solids is obtained by continuous heat-exchanger blowdown or some other means. I say "some other means" since there is no reason why, if blowdown for dissolved solids deconcentration is arranged from the correct point in the boiler, this value cannot be kept to an absolute minimum.

Experiments have shown that maximum-dissolved-solids concentration is found within two ft of the upper water surface of the boiler, and hence blowdown from the surface is most effective in lowering the value. When only bottom or lower-water-line blowdown valves are used a tremendous amount of blowdown is necessary if the total-dissolved-solids concentration is to be reduced.

In one test boiler plant, a value of 20% blowdown was found necessary, with particularly bad water when only bottom blowdown was used. When surface blowdown was used and minimum of sludge blowdown added to that, total quantity of water blown down in any one day amounted to less than 7%, a reduction, therefore, of some three to one.

ALAN WILSON, *London, G.B.*



Install evaporator

LHG wants an "inexpensive" way to control sludge and reduce blowdown caused by contaminated condensate.

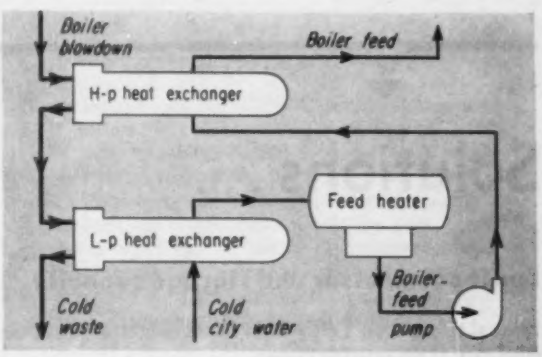
I believe that the best way is cheapest in the long run, although initial installation costs may appear high. Efficiency of the setup above should pay for itself over "cheaper" less-efficient methods in a couple of years.

Impure condensate enters evaporator, where it is distilled off into steam. This steam feeds steam inlet of deaerating feedwater heater where it deaerates and heats fresh feedwater makeup as well as supply pure returns.

Evaporator must be blown down from time to time to avoid buildup of impurities, but evaporator blowdown is only significant loss involved in this system. Further improvement can be had by installing water softener before evaporator and adding continuous blowdown to the boiler (discharge of blowdown also entering evaporator). This will cut heat loss to minimum.

Except for what is required to maintain the water-softening equipment, you'll save time and money: chemical treatment to the boilers will be minimized, losses from blowdown will be greatly reduced.

E POLIKOFF, *Bethpage, N. Y.*



Install continous blowdown

I can only assume from data given that the plant operates 24 hr a day and that 552,000 lb steam is generated daily. Present blowdown of 8% (45,160 lb of water daily) could be cut to 4% or less. Immediate savings in fuel, water and treatment chemicals could be realized by installing a simple continuous-blowdown system with heat-recovery unit. Other savings would follow as a matter of course: steady, even steam pressure on steam mains throughout plant's process system, less wear and tear on the burner and combustion controls, labor saved by automatic instead of manual blowdown and saving resulting from heat formerly wasted being diverted to feedwater heater and high-pressure boiler feed.

I suggest that a continuous-blowdown system based on schematic, above, be installed. *LHG* can either purchase the system or have his plant maintenance force make one. Only an on-the-spot survey could closely predict the possible savings, but the idea is worth a try.

JOHN KING, *Brighton, Mass.*

Problem . . .

What's best way to handle increased compressed-air loads?

Our plant uses a large amount of compressed air for automatic machine operations, cleaning and process use. The actual plant is over 20 years old, but compressed-air system was enlarged and centralized about five years ago.

Present equipment consists of three 4200-cfm compressors supplying 110-psig air to a plant-distribution system. As process automation and general air demand grew in the past few years, our compressors have been increasingly hard pressed to supply air to new loads tagged on the end of the air-distribution system. We are sometimes caught short for pressure at extreme end of air lines.

Our current problem is how to boost capacity without spending a great deal of money. Because average air load runs about 11,500 cfm, with periodic peaks of 13,300 cfm, we have talked of increasing line capacity to cut pressure drop. This appears to be expensive for the small capacity increase that would result. What do readers suggest?—*LHG, November* POWER

Solutions . . .

Boost compressor and storage capacity

Several things that *LHG* could check might increase the efficiency of his existing system.

Watch location of air-intake filters. They should preferably be located in a shaded spot or on north side of building where intake air will be as cool as possible. Warm intake air cuts down capacity. Make certain of ample clearance all around filters for air to enter. Make sure filters are clean and oil level properly maintained.

Air-intake pipes from filters to compressors may be too small. Intake piping should be at least as large as the compressor opening. If the intake pipe is long it should be increased one in. in diameter for each ten ft of run. Intake-air velocity should be less than 2500 ft per minute for the best performance.

Discharge temperatures and pressures should be carefully checked to determine that existing compressors are putting out their rated capacity.

By adding more air receivers and piping, it might be possible to provide additional air for peak-load conditions. One additional air receiver approximately 4 ft, 6 in. in diameter by 14-ft long would provide approximately five minutes extra peak-load operating time. Two receivers would provide ten minutes added operating time.

There are two things that could help loss of pressure: (1) install an auxiliary air receiver near point of heavy usage (2) install a loop header to divide flow of air and reduce pressure drop to end-of-line loads.

I believe the best answer is to install one new compressor of same capacity as three existing units and go ahead and revamp piping into loop system. Extra compressor would supply needed capacity for peak-load conditions and would be available to act as a standby unit for other compressors, which are now operating at very near rated capacity. While this might cost more money now than *LHG* wishes to put into plant expansion, I am sure he'll find that sooner or later his peak load will increase. Then he'll have the capacity there when required. He will also cut production downtime due to compressor overhaul to occasional emergency work.

LHG should remember that he is not saving money if he needs air for tool operation and doesn't have it available in sufficient pressure and quantity to do the job. Such a condition allows man-hours to pile up and also means a loss of production. Both of these cost a plant considerable money, may even result in lost orders.

It is evident that plant requirements have increased in the last five years to where the air compressors and piping installed then are now inadequate for peak-load conditions. Planning ahead will avoid loss of production and man-hours—probably enough to pay for additional equipment easily and still save the plant money.

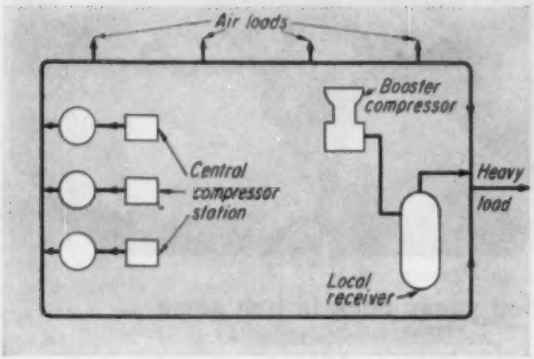
R HIGGINS, *Long Beach, Calif.*

Install air receiver

Problem could be solved by installing an air-storage tank in the end of the air-distribution system at point most distant from the compressors. Then as peak demands occur, reserve supply stored in the tank will satisfy the demand for the duration of quick surges.

Installation of the tank would be much more economical than increasing line size to cut pressure drop.

A J PANDIN, *Alliance, Ohio*



Install compressor at load

Best way out is to install a peak-load compressor. This compressor should be installed at the point in the system that has low-air-pressure troubles. Set controls on unit at three or four psi above the lowest desirable pressure and have it cut out at about 100 psi. Set up in this manner it would operate only when existing equipment became overloaded. Although this does tend to decentralize the air-production department, I feel that it would be justified because the unit would operate only on a part-time basis. Scheme has in its favor the fact that it will put the air *where* it is needed *when* it is needed without revamping the existing piping system.

R J NEIERT, *Cincinnati, Ohio*

Install loop system

Frequent cause of a compressed-air system not delivering required capacity is leakage in piping system and air-consuming equipment. Leaky pipe joints, poorly seated and open valves as well as cracked hose are common causes of air loss. I suggest that *LHG* inspect his piping circuits and connected equipment.

When a compressed-air system is installed, piping should be sized not only for initial demands but also for estimated future requirements. For an economic and reliable system, sizes should be large enough so that pressure drop between air receivers and points of use does not exceed approximately 10% of initial pressure.

A loop system throughout the plant provides 2-way distribution to area with greatest air demand. With proper valving, loop arrangement also permits passing air to any part of plant without interruption if a section of piping is out of service. This can pay off quickly.

Long lines should be provided with ample-sized receivers located at the far ends of system or at locations where occasional heavy load occurs. Usually peak demands for compressed air are instantaneous or of short duration. By providing storage capacity in the area where these peaks occur, excessive pressure drops may be avoided—while surge is less than tank capacity.

Receiver serves as a reservoir for storing air to meet sudden demands in excess of compressor capacity. Careful sizing and arrangement of receivers are necessary to give satisfactory service. For a compressor having constant speed regulation and delivering 4200 cfm, recommended minimum standard receiver size is 60-in. diameter by 16-ft long. This provides a storage volume of approximately 314 cu ft. For automatic start-stop service this receiver size is suitable for about one-half the compressor displacement. This avoids too-frequent compressor starting.

H B WAYNE, *Woodhaven, N. Y.*

Your February problems

Can we control stack emission?

Our plant operates four 30,000-lb-per-hr oil-fired packaged boilers for plant-heating and process needs. Units carry two-thirds to full load most of the time. We fire No. 6 fuel oil obtained from a single source, with a desludging additive included for best pumping.

Although our combustion controls are kept in good operating condition, we constantly receive complaint notices from our municipal smoke-control inspectors. We are cited for a periodic white plume which under certain lighting conditions appears quite dense.

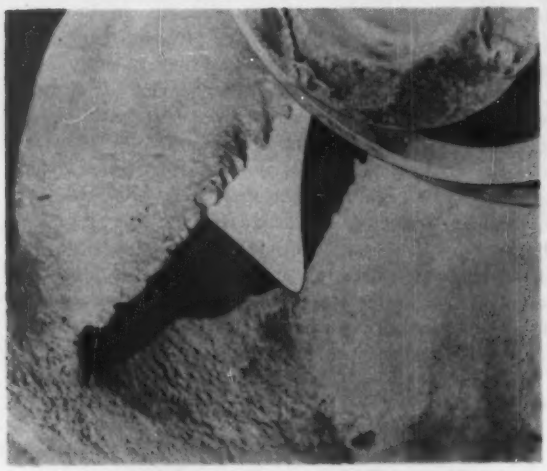
We have checked control settings, flue-gas analysis and everything else we could think of, while generating a plume and with a clear stack. So far we haven't been able to pinpoint anything, and are expecting to get a summons any day. We'd like to hear from any POWER readers who have had this problem and found a solution.—*HCM*

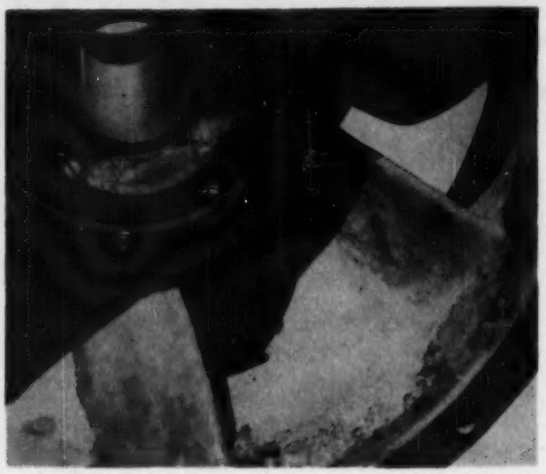
What's wrong with our pumps?

In our 125,000-kw unit, the horizontal No. 1 l-p heater cannot be controlled. Heater has a drain-cooler section, with drains pumped to condenser by either of two full-capacity heater-drain pumps. Although we are sure that the npsh requirements of the pumps are adequately met, water level in the heater cannot be pulled down to the design point, even with both pumps running together. Can you suggest some reason for this difficulty?—*LMS*

Sit down right now and answer one or both problems. We'll pay extra for answers with photos or sketches.

Timely **practical ideas** to help solve





Resin-fiber-glass team puts diffusion vanes back in ball game

Bronze diffusion vanes on eight large condenser circulators deteriorated under severe corrosion-erosion attack by sea water and sand, first photo. Inlet-vane tips were irregularly grooved. Deep pits and channels were scored in the diffuser shells. These eventually could have worn through.

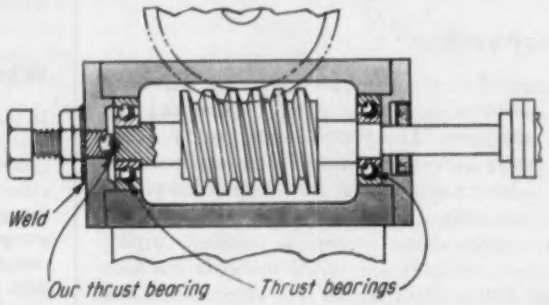
The pumps were thoroughly cleaned by sand blasting and a coat of resin was brushed on entire pump interior (see POWER, Apr 1959, *Put epoxy resins to work on your knotty repair problems*). Pits and channels in the vane tips, fillets and shells were built up with a low-temperature-setting resin putty. A woven fiber-glass matrix was placed on the filled surfaces and brush-coated with resin. Fiber-glass cloth was then applied with another coat of resin, right.

After two years' service, the repair appears to be permanent. Cost was low when compared to price of replacing these large diffusers.

Stainless-steel impellers are used on these circulators and no damage was noted. But had the impellers been made of bronze or cast iron, resin repair of similar damage would have presented a problem: since density of resin is much lower than either cast iron or bronze, proper rebalance after extensive repair would be very difficult and expensive.—*Courtesy, Narmco Resins & Coatings Co*

This homemade thrust bearing helped us out of our difficulties

We have a small speed reducer on a 60-lb washer in our laundry. Motor reverses its direction of rotation every six seconds, thus reversing direction of thrust. When thrust is towards the motor, motor bearings absorb some of it. But when thrust is in the opposite direction one bearing must counteract the entire force. This bearing would not stand up for any length of time, so we devised an additional thrust bearing.



First we countersunk and hollow-ground idle end of the shaft. Then we drilled and tapped the speed-reducer case for a steel set screw. We made it size of shaft and in line with shaft, after welding a nut onto the case, sketch. This nut strengthens the housing and provides more thread area. Set screw was then ground off, countersunk and hollow-ground the same way. A lock nut was placed on the set screw and screw inserted in case. A ball from an old bearing was placed between the hollow end of the set screw and the shaft. We then turned the set screw until a very slight pressure was exerted on ball and

your tricky design and maintenance problems

STEVE ELONKA, Associate Editor

shaft. Our invention worked just fine.

We also used this idea when installing a small exhaust fan, designed for horizontal positioning, in a vertical position on the ceiling. We had to have something with the least possible friction to support weight of fan blades and armature as well as fan thrust.

J M BASS, *Waukesha, Wis.*

Do you get along?

The guy who gets along learns that life is a mixture of good days and bad, victory and defeat, give and take. He learns not to be sensitive, to let some things go like water off a duck's back. He learns loss of temper usually makes a loser. He learns all men have burnt toast for breakfast now and then, and not to take the other fellow's grouch too seriously. He learns that carrying a chip on his shoulder is easiest way to a fight—and this is most important.

He learns that a quick way to become unpopular is to carry tales and gossip. He learns most people are human and it doesn't do any harm to smile and say 'good morning' even if it's raining. He learns other fellows are as ambitious as he, that they have brains as good or better and hard work, not cleverness, is the secret of success.

He learns it doesn't matter who gets the credit, as long as the business goes on well. He comes to realize the business could run without him. He learns to sympathize with those coming into the business because he remembers how bewildered he was when starting. He learns that no man gets ahead alone and that it's only through cooperative effort that we move on to better things. He learns that the fellows are not any harder to get along with in one place than another, and 'getting along' depends about 98% on himself.

ANONYMOUS

What would you have done?

Years ago, I was second man on the 12 to 8 watch at the old Bay Shore substation of the PG&E Co. A third bank of transformers had been installed to temporarily increase the capacity of the plant while a new substation was being built. Because there wasn't room in the building for all the equipment, the instrument transformers were mounted on a temporary wooden structure outdoors. Under some climatic conditions, there were heavy static discharges from the insulators of this equipment.

One morning at 2 am a fire broke out on a pole supporting an instrument transformer. This transformer rested on a steel channel on top of a wooden pole and had a diagonal brace from the channel held by a lag bolt in the pole. A pocket of dry rot had developed around the lag bolt and fallen out, leaving a gap between the end of the bolt and the pole. Static traveling down the brace had jumped the gap to the punk wood and set the pole on fire.

The first operator got an OK from the load dispatcher to shift the load and take the transformer bank out of service. As soon as the operator assured me that the equipment was dead, I entered the enclosure. It was a clear cold night. A strong north wind was blowing, fanning the fire and keeping it alive. Knowing that gas from a pyrene gun would be blown away by the wind and have no effect, I decided to put the fire out with a bucket of water.

The first operator told me that I should not have used water on an electric fire. But I pointed out that with a fire burning in a high wind there was nothing else that would have done the work. The chief operator arrived shortly afterward. He agreed that while using water wasn't proper, I had done the only thing possible under the circumstances. What would *you* have done?

H T LIVINGSTON, *Los Angeles, Calif.*

Why does low voltage kill?

You can't feel a 1-milliampere current. From 1 to 8 ma, shock isn't painful. From 15 to 20 ma, shock is painful, muscular control is lost and you can't let go. From 20 to 50 ma there is a painful, severe muscular contraction; breathing becomes difficult. A 50- to 100-ma charge often causes death, so be careful.

Do you know . . .

minimum steam-generator capacity requiring a licensed boiler operator in every city and state in our country? Chapter 20 of the new *Standard Plant Operators' Questions and Answers* will give you the answer to this and a lot of other questions on many subjects. The 2-book set is published by McGraw-Hill Book Co.

More **practical ideas**

Don't be short changed by hot oil

There are still a few people in the oil business who try for a fast buck by cheating on deliveries. Every truck has a calibration tab and a gross gallonage assigned by the Bureau of Weights and Measures. If you check to see that the tank is filled to the mark and then check again to be sure the driver didn't forget to pump one compartment, you can be sure you have received your correct gross gallonage. Make this standard practice when receiving fuel oil.

A more subtle way to chisel a few gallons is to deliver hot oil at a high temperature and bill it at a lower temperature.

Oil is billed at the standard 60 F, but for ease of handling is usually delivered at 120 F. Correction then becomes:

Gross gallons	Temperature at delivery	Temperature correction	Net gallons at 60 F
5000	120	0.9792	4895
5000	140	0.9723	4862
5000	160	0.9655	4828
5000	180	0.9587	4794
5000	200	0.9520	4760

Line 1 is the correct billing for oil delivered at 120 F. You pay for the net of 4895 gallons. But if the oil is 180 F, you are being cheated of 4895 – 4794 or 101 gallons per load.

We had no practical way to check temperature as oil is delivered to buried tanks through short fill drops. First we tried dropping an ordinary thermometer into the tank trucks, but it proved useless. Why? By the time we wiped the thermometer clean on a cold night the reading had dropped 20 F or more.

I found a maximum reading thermometer. It's really a clinical thermometer built to more rugged commercial standards, including a metal case that records the maximum temperature and holds it indefinitely. We can take it inside and read it at our convenience. Before the next reading it must be shaken down like any clinical thermometer.

For large consumers, the little bites shown in the table can be substantial. During the heavy winter months we obtained rebates of over $100 per month by correcting temperature. Thermometer costs under $5.00. Hung from the lip of the truck fill-port by a hook, it is suspended about at the midpoint in the tank.

J STEINERT, *Fresh Meadows, N. Y.*

Fires in '58: 1,994,000 — cost: $1,279,000,000

Did you add to these loss figures?

Electrical	117,000 fires	$183,499,000 loss
Rubbish	57,900 "	22,984,000 "
Flammable liquids	53,500 "	49,985,000 "
Open flames, sparks	52,500 "	66,424,000 "
Lightning	33,400 "	31,594,000 "

Courtesy, National Fire Protection Association

My biggest boner

While chief engineer on a coaster, I inspected the fresh-water tanks one day. Several baffles were loose and tanks needed a good cleaning.

Several days later tank cleaners and a welder showed up. As the super took charge, I was relieved of the responsibility. Welder entered the tank and started tacking the loose baffles in place. His assistant stood by the manhole and warned him of fumes. But the welder wanted to finish as he was cramped in the tank.

Suddenly the welder yelled, "I'm on fire!" The assistant stuck his pyrene fire extinguisher down into the manhole and pressed the trigger. But when pyrene strikes hot material, deadly phosgene gas is generated. Result was that the welder died before he could get out of the tank.

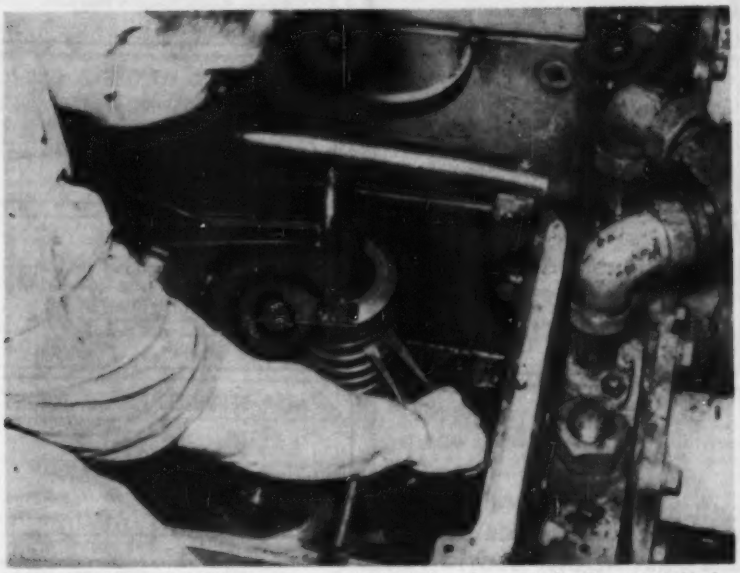
They sent for me and two hours later we had cut a hole directly above the welder and removed his body.

Here's what my investigation showed: No fresh-air fan and no exhaust fan had been used. The filling-pipe plug had not been removed. Only one opening was used—the manhole—and the welder was cramped so it would take several minutes for him to release himself. There was no suitable fire-fighting equipment such as sand, soda acid or portable water hose with spray nozzle. No oxygen supply in case the welder was overcome by gas fumes. The welder was completely out of sight of his helper.

No doubt there are even more precautions to take when welding in a confined space. But had the person responsible made a careful study before letting the welder enter the tank, I'm sure that man would be alive today. It was a most serious error to send him into the tank under the circumstances. I sincerely hope that readers learn from this tragedy.

F C LONGHEED, *Victoria, B.C.*

EXHAUST VALVES and seats on this pumping-station diesel lasted only 600 operating hr



HARD-SURFACED VALVES now operate for 1800 hr when periodically rotated 30 deg

Save those valves

By NATHAN ARAD, Yarkin Project, Israel

Wear of exhaust valves and seats became a big headache when we switched to burning light diesel oil of 450-sec Redwood No. 1 at 100 F, preheated to 200 F. But we finally overcame this problem.

Our engines are heavy-duty 4-cycle 8-cylinder single-acting turbocharged units, with a 16-in. bore and 20-in. stroke. Engines have vapor-phase jacket cooling and are rated 2085 bhp at 375 rpm. Thus far they've had about 15,000 hr of operation. Nine such engines are installed in three identical pumping stations along the same water main. On an average two out of three engines in each station are in operation. But during the heavy irrigation season we need them all; no standby is available for maintenance shutdown.

Burning light fuel oil produces a layer of sodium sulfate, Na_2SO_4, on the exhaust-valve head. In time this layer hardens and gets brittle, mainly from valve hammering on its seat. After about 100 operating hours the layer is so thick that further hammering causes it to crack. Exhaust gases, seeking passage from the combustion chamber, penetrate these cracks and later escape at high speed. That erodes the valve head and its seat. But the sodium-sulfate layer is easily soluble in water.

Erosive action starts about 150 operating hr after a new valve is ground and fitted into its seat. After about 600 operating hr valves and seats are so badly destroyed that fuel burning isn't confined to combustion chamber alone. Burning takes place in the exhaust manifold and on the pyrometer sensing device. This sensing device immediately starts to record higher temperatures while combustion-pressure cards indicate low pressures.

Maintenance meant routine 600-hr shutdown for valve grinding. Job took about 150 man-hours, and each engine was idle for about three days. We hard-surface welded all valve heads with 0.080-in. layer of Haynes No. 6 stellite. Layer would last about 1800 operating hr but needed grinding and fitting after every 600 hr.

We worried more about valve-seat wear because seats are an integral part of head casting. Some seats wore so much we had to order special valve-seat inserts. Conditions got worse until we were using inserts at a rate of three a month.

Observing hundreds of these worn valves, we noticed the wear is usually more common on the valve head section, closest to the injector. On injector side the sodium-sulfate layer is thicker, so it cracks earlier and permits an earlier escape of exhaust gases. This gave us an idea.

Last March we decided to test one engine to determine effect of manually and intermittently rotating the valves. We used a simple lever for relieving spring pressure on valve. Then we rotated valve with a pair of tongs, bottom photo. Every 48 hr we shut down engines and rotated exhaust valves 30 deg. This operation took two men ten minutes. Period was short enough to permit shutting down and restarting on light fuel oil.

Steady-state conditions were reached minutes after starting, so this operation didn't have the wear-and-tear effects associated with starting an engine from cold. Our test engine more than doubled normal running time between valve grinding. After 1500 operating hr we dismantled the heads. Valves and seats were still in perfect shape. Two more engines were tested after a period of 1800 hr. That helped us establish the positive results of manual, intermittent exhaust-valve rotation.

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100	F.M. S.B. Open	H200	900
100	F.M. S.B. Open	H	720
100	F.M.S.B. Open	H	600
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Inquire about our **UNIT EXCHANGE PLAN** that avoids costly downtime and can save you money. Applies to Fairbanks-Morse model 38D, Cleveland models 278A and 268A, GM Electro-Motive Division model 567.

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675 HP COOPER-BESSEMER DUAL FUEL DIESEL-GAS. 500 KW. 3/60/2300V. COMPLETE.
1275 HP COOPER-BESSEMER DUAL FUEL DIESEL-GAS. 900 KW. 3/60/2300 V. NEW 1953.
3000 KW GE CURTIS CONDENSING TURBO. 400# ISP. 3/60/2300 VOLTS. BUILT 1930. COMPLETE. EXCELLENT.
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DIESEL ENGINE GENERATOR UNIT
575 HP, 600 RPM, Worthington Type DH-6 Diesel engine direct connected to 500 KVA—400 KW, 80% PF, 600 RPM, 3 phase 60 cycle, 240/139 volts Electric Machinery synchronous generator complete and equipped with exciter, switchboard with instruments, attached and unattached auxiliaries to the engine. Slightly used—practically new. Immediate delivery.
UTILITIES MACHINERY CORPORATION
1965 East Sixth Street, Cleveland 14, O.

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FOR SALE
14 NEW TURBINES
4 horizontal, 10 vertical, Westinghouse
Driving forced draft blowers—capacities ranging from 39000 to 56000 CFM and 16" to 24" pressure. Steam pressures 360 to 575#, back pressure 10#.
Will sell turbines separately if desired.
Price reasonable.
Also—1—250 KW GE turbo generator unit, 3 phase, 60 cycle, 440 volts. Used one year.
G. M. De ROSE
2457 WOODWARD AVE.
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MODERN GE RECTIFIERS
3/60/13,200 AC to 600V. DC
4—1000KW Mod. 6RC-45-CD6
2— 500KW Mod. 6RG-45-CH2
Six Tube Ignitron Pump Type
Full Automatic AC & DC Controls
Can be inspected on original locations now in 1948, still like new, actual photos are available, very low price for lot.
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Oldest Shipbreaking Firm in the U.S.A.

OFFERS NEW EQUIPMENT FROM THE UNCOMPLETED

BATTLESHIP U.S.S. KENTUCKY

Equipment installed but never used—all built to Navy standards of finest materials

TREMENDOUS SAVINGS ON ALL POWER EQUIPMENT!

PUMPS

10 MAIN FEED PUMPS

PUMP: Ingersoll-Rand — size 5" — three stage — capacity 500 GPM @ 750# discharge pressure. B.H.P. 330 — 5000 RPM. *TURBINE:* Worthington-Moore — design pressure 575#/sq. inch — non-condensing — back pressure 20# — 5000 RPM — 330 B.H.P.

GEARED TURBINE-DRIVEN MAIN FEED BOOSTER PUMPS

PUMP: Mfg. by Buffalo Pump Co. — vertical single stage — capacity 550 GPM — 30# discharge — 8" suction — 5" discharge. *TURBINE:* 1 stage impulse — type Y-W — vertical — design steam pressure 575# — back pressure 20# — 12.5 HP — 5500/1750 RPM — mfg by Terry Steam Turbine Co.

2 MAIN FEED BOOSTER PUMPS

Same as geared turbine driven main feed booster pumps above, but with 14.5 HP 440/3/60 AC Star motor & Ward Leonard control. Across-the-line starter with pushbutton.

8 GEARED TURBINE-DRIVEN VERTICAL CONDENSATE PUMPS

PUMP: Main condensate 2-stage vertical pump — mfg by Buffalo Pump Co. *Capacity:* 375 GPM — 70#/sq. inch discharge pressure — 1150 RPM — 22.5 BHP — 9" suction — 4" discharge. *TURBINE:* Single stage — 575# working pressure — 20#/sq. inch back pressure — 22.5 HP — 5360/1150 RPM — Mfg. by Terry Turbine Co.

2 AUX. FEED BOOSTER PUMPS

PUMP: Vertical — mfg by Buffalo Pump Co. — 200 GPM — 30# discharge pressure. *MOTOR:* 7.36 HP — 1800 RPM — 440/3/60 — Star motor, with control.

BRONZE RECIPROCATING STANDBY FEED PUMPS

11 x 8 x 18 — mfg by M. T. Davidson Co. — vertical simplex — capacity 180 GPM — 800/900# discharge pressure — 575# working pressure.

4 TURBINE-DRIVEN FIRE AND FLUSHING SERVICE PUMPS

PUMP: Worthington — horizontal centrifugal. *Fire Service:* 750 GPM capacity — 150 PSI discharge pressure — 3500 RPM. *TURBINE:* single impulse — type B-20 — mfg by B. F. Sturtevant — design steam pressure 575# per sq. inch non-condensing. Back pressure 15# — B.H.P. 80/90.

3 GEARED TURBINE-DRIVEN MAIN CIRCULATING PUMPS

PUMP: Mfg. by Worthington Pump & Machinery Co. — 28" type — vertical single stage — bronze. *Capacity:* 28,000 GPM — discharge pressure 135# — 600 RPM — 267 BHP — 28" suction — 28" discharge — 8.5:1 gear ratio. *TURBINE:* single impulse — vertical type — 575# design steam pressure non-condensing — back pressure 15#/sq. inch. RPM 5100 pinion — 600 gear. Reduction gear ratio 8.5:1 — 267 BHP — mfg by B. F. Sturtevant.

3 MOTOR DRIVEN MAIN CONDENSATE PUMPS

Mfg. by Buffalo Pump Co. — vertical 2-stage —375 GPM — 70#/sq. inch discharge pressure — 1150 RPM. *Motor Data:* 25 HP — 440/3/60 — 1150 RPM — Star Electric Motor Co. — with across-the-line starter, with pushbutton station — mfg by Ward Leonard.

8 GEARED TURBINE-DRIVEN MAIN LUBE OIL PUMPS

Mfg. by Northern Pump Co. *PUMP:* Vertical rotary type — 750 GPM — 55#/sq. inch discharge pressure — 263 RPM — 35 BHP — oil viscosity 130 to 500 S.S.U. — 7" suction — 6" discharge. *TURBINE:* Single stage — 575# design pressure non-condensing — exhaust pressure 15# — 35 BHP — 26.39:1 gear ratio — 6940 RPM.

4 TURBINE-DRIVEN GEARED FUEL-OIL BOOSTER PUMPS

Mfg. by Northern Pump Co. — vertical rotary — 300 GPM — 150# discharge pressure — 282 RPM — 47.3 BHP — Oil viscosity 70-700 S.S.U. — 7" suction — 5" discharge. *DRIVE:* single stage impulse — 575# non-condensing — 15#/sq. inch discharge pressure.

6 FUEL OIL SERVICE PUMPS

Mfg. by Northern Pump Co. — vertical rotary — 85 GPM — 350# discharge pressure — 560 RPM — 27.4 BHP. *TURBINE:* 1 stage — 575# non-condensing — exhaust pressure 15# — mfg. by Northern.

VALVES

THESE ARE JUST A FEW OF THE MANY VALVES OFFERED. ALL TYPES ARE AVAILABLE INCLUDING REDUCING—SENTINEL—RELIEF—MICROMETER — PRESSURE REGULATING — ANGLE, ETC! STEEL—600# SERVICE—SEND US YOUR REQUIREMENTS FOR QUOTATIONS

LESLIE 2" GOVERNOR VALVES

Type C.P. — class A — capacity 7640#/hr. — 575# steam pressure — 750# discharge pressure.

MOTOR OPERATED GATE VALVES

Low Pressure — comp. geared — 38" — mfg by Chapman Valve Co. *MOTOR DATA:* H.P. 18 ft. lbs. running torque — 45 ft. lbs. max. starting torque — 440 volts 900 RPM 3 phase 60 cycle. Type: Submersible Valve Brake — Motor: Star Electric Co.
Also available, same as listed, but 36", and 28" inch as listed, but with smaller motor.

MISCELLANEOUS

18 WIDE-RANGE FORCED DRAFT TURBINE-DRIVEN BLOWERS

9 R.H. — 9 L.H. — mfg by B. F. Sturtevant — propeller fan type — capacity 29,500 CFM/5540 RPM/250 BHP — 8250# steam/hr. — and, 9,000 CFM/1985 RPM/9 BHP — 690# steam/hr. — 7 blades — static: max 35" water — normal 21.5" water. Driven by Sturtevant turbine type VC-7 — non-condensing — single stage — 250 HP — 575# steam pressure — 15# PSIG exhaust pressure.

1250 K.W. WESTINGHOUSE TURBO-GENERATORS

(4) — Westinghouse—440/3/60—850°—540 lbs. working pressure. Complete with condensers, circulating pumps, etc.

LUBE OIL COOLERS

4 — mfg by Westinghouse. 1600 sq. ft. cooling surface — cylindrical straight-tube horizontal type. Oil capacity 590 GPM — water capacity 1500 GPM — temp. oil inlet 150°F — outlet 120°F — temp. water inlet — 85°F — outlet 90°F. Number of ⅝" tubes 816 — Wall 0.049 TK — Cupro-Nickel.

MAIN CONDENSERS

Mfg. by Foster-Wheeler — 23,500 sq. ft. cooling surface — 40,500 GPM circulating water — total tubes 8,976, or cupro-nickel, as follows: (550) each ¾" x 0.066 and (8416) each ⅝" x 0.049. Monel water boxes.

BOILERS

7 B&W EXPRESS TYPE

Design pressure 634# — operating pressure 565# — temp. 850°F. Oil fired — separately fired superheaters. *Capacity:* 210,000 lb. steam/hr. ideal for testing where large quantities of steam are required, giving excellent control from separately fired superheaters.

3 GLAND EXHAUST CONDENSERS

Foster-Wheeler — total capacity lbs./hr.: 1200 lbs. steam and 350 lbs. air — 155 sq. ft. — 4" ejector.

LARGE DEAERATING FEED HEATERS

Monel construction — spray type — capacity 480,000 lbs./hr. — vent condenser — single pass — heating surface 174 sq. ft. — all Monel construction.

GE HIGH AND LOW PRESSURE MAIN PROPELLING TURBINES

WILL SELL SEPARATELY FOR TESTING, WIND TUNNEL OR SIMILAR WORK. (2) *High pressure* — 24,400 HP — 12 impulse stages — 4909 RPM — working pressure 540# — 825°F, (2) *Low Pressure:* 28,600 HP — 3913 RPM — working pressure 49# steam — 424°F — 2-6 stages of impulse.

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Thousands of new and "Certified Rebuilt" Motors & Generators in stock—up to 1000 H.P.

OUR 54th YEAR

A. C. MOTORS—60 CYCLE

HP	Mfr.	Type	Volts	Speed
800	Whse. (2)	Sq. Cage	2300	1800
750	G.E.	Slipring	2300	514
700	Whse.	Slipring	2300/4000	1200
600	G.E.	Synch.	480	900
600	Elliott (2)	Sq. Cage	2300	900
500	Allis Ch.	Slipring	2300/440	600
400	G.E.	Sq. Cage	440	1200
400	Whse.	Sq. Cage	2300	514
400	Marathon (2)	Sq. Cage	2300	2000
400	G.E.	Slipring	2300	514
400	El. Machy.	Synch.	2300/4000	400
350	Nr. Boveri b.b.	Sq. Cage	4000/440	720
350	G.E.	Sq. Cage	2300	1800
350	G.E.	Slipring	440	1200
350	Allis Ch.	Slipring	2200/4000	600
350	G.E.	Slipring	220/440	900
300	Whse.	Synch.	440	1200
300	G.E.	Slipring	220/440	514
250	G.E.	Sq. Cage	2300/440	1200
250	G.E.	Sq. Cage	2300/440	450
250	Gen. Elec.	Sq. Cage	440	3600
250	G.E. TEFC	Sq. Cage	440	1200
250	Whse.	Sq. Cage	2300/440	600
250	Whse. (4)	Slipring	2300/440	600
200	G.E. b.b.	Sq. Cage	220/440	720
200	G.E.	Slipring	220/440	450
200	G.E.	Slipring	440	600
200	G.E.	Slipring	2200	900
200	Reliance b.b.	Sq. Cage	220/440	1800
200	Allis Ch.	Slipring	2300/440	720
150	G.E. b.b.	Slipring	2300/440	720
150	G.E. b.b.	Slipring	2300/440	720
150	Whse. XP	Sq. Cage	440	3600
150	G.E. (4)	Slipring	2300/440	600
150	G.E. (2)	Sq. Cage	2300/440	1800
150	Whse.	Slipring	220/440	1200
150	G.E.	Sq. Cage	2300	900
125	A.C. TEFC	Sq. Cage	220/440	1800
125	El. Machy. (2)	Synch.	220/440	600
125	G.E. TEFC	Sq. Cage	2300	3600
125	Al. Ch. TEFC	Sq. Cage	220/440	600
100	Whse. TEFC	Sq. Cage	220/440	1200
75	G.E. b.b. (8)	Sq. Cage	220/440	1200

D. C. GENERATORS

KW	Mfr.	Type	Volts	Speed
200	Gen. Elec.	RC	250	1450
100	Delco b.b.	Iate	120/240	1200
75	Allis Ch. b.b.	EB-146L	125	1800
75	G.E. b.b.	CD	250	1750
60	Ideal	D	125	1150
60	G.E. b.b.	CD	600	1750
50	G.E. (2)	CD-1129	250	1200

D. C. MOTORS

HP	Mfr.	Type	Volts	Speed
250	Cr. Wh.	161-H	230	1150
200	G.E. (2)	RC-38	230	1150
200	Whse. b.b.	SK	230	287/575
175	Cr. Wh.	150-H	230	500
150	Rel. TEFC b.b.	2550-F	230	850
150	Whse.	SK-210	230	330/1000
125	G.E.	CD-172	230	575/1150
100	Elliott b.b. T.E.	JH-FE	230	1150
100	El. Dyn. b.b. (2)	30-S	230	450/1200
80	Whse. dyn. b.b.	SK-123L	250	1800/5000
75	Whse. (3)	SK-160	230	550/1150
75/100	Whse.	SK-191	230	300/900
60	G.E. TEFC b.b.	CD-125	230	1150
50	G.E.	RF-16	230	350/1000
50	Century new	DN-514	230	1150/1750
40	Whse.	SK-163	230	300/1200

MOTOR-GENERATOR SETS

KW	Mfr.	Input V	Output V
600	Allis Ch.	440 AC	250 DC
300	Whse. (2)	2300/440 AC	250 DC
200	Gen. Elec.*	220/440 AC	125 DC
125	Gen. Elec.*	2300/4000 AC	250 DC
125	Whse.	220/440 AC	250 DC
100	Delco b.b.	220/440 AC	120/240 DC
80	Star b.b. Synch.	220/440 AC	250 DC
75	G.E. b.b.	220/440 AC	250 DC
75	G.E.	220/440 AC	125 DC
50	G.E. b.b. (3)	220/440 AC	250 DC
35	Reliance b.b.	220/440 AC	250 DC

Arthur Wagner Co. Certified

MOnroe 6-7409
1435 W. RANDOLPH ST.
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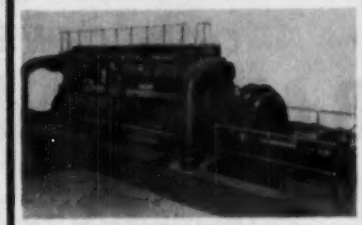
DIESEL ENGINE GENERATOR SETS

Immediate Delivery from Inventory!



Any voltage; 50 or 60 cycle. Available in stationary, mobile or portable model. Following listing is only partial.

1420 kva Fairbanks-Morse model 38D—8⅛ (photo above)
1375 kva General Motors model 278A
1250 kva General Motors model 567
938 kva General Motors model 567
625 kva General Motors model 278A
625 kva American Locomotive Co. model 539
412 kva Worthington model CC
375 kva General Motors model 268A
312 kva General Motors model 268A
250 kva General Motors model 268A

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Circle 523 Reader Service Card

DUAL FUEL & DIESEL ENGINE GENERATOR UNITS

1250 KVA Worthington supercharged diesel engine generator unit 3 phase 60 cycle
2400/600/480 volts 360 RPM
New 1949—Excellent condition

1050 KVA Nordberg supercharged diesel engine generator unit 3 phase 60 cycle 2400 volts
327 RPM
New 1947 — Excellent condition

The above units are still installed and can be adapted for Dual Fuel operation.

INTERNATIONAL POWER MACHINERY CO.
1612 Union Commerce Building
MAin 1-9514
Cleveland 14, Ohio

Circle 519 Reader Service Card

MOTORS — GENERATORS

75 HP CW DC 230V TEFC 900 RPM
500 HP 3/60/440/514 RPM Elec Mach Syn
600 HP West. DC 230V 150-190 RPM
4—1200 KW Allis Chal DC 525V 720 RPM
17—1500 HP west (new) DC 525V 600 RPM

AC to DC MG SETS

50 HP GE 1750-42 KW DC 230V 4 B.B.
125 HP Rel Syn 1200-100 KW DC 230V 3 B.B.
125 HP Elec Prop 1200-75 KW DC 150V 4 B.B.
250 HP West Syn 1200-150 KW DC 125V 3 Sl. B.

ALL SIZES AC & DC MOTORS & CONTROLS

ALBERT HELLER'S SHIP SUPPLY CORP.
87 Hamilton Ave., Brooklyn 31, N.Y.
ULster 5-8643

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BOILER

1—200 HP Kesler, type CP, 100 psi, stoker fired, 1945

COAL PULVERIZERS

1—Kennedy Van Saun 7' x 9' air swept ball mill, integral gear drive.
1—Babcock & Wilcox 832E ball-ring pulverizer, air swept, 75 HP.
2—Raymond 3432 ball mills, 125 HP, prest. UNUSED.

WRITE FOR DETAILS

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1422 N. 6th St., Philadelphia 22, Pa.
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TRANSFORMERS

1—6667 kva, Westinghouse 3/60/115,000Y/13750
1—6000 kva G.E. 3/60000/2400/4160Y
1—2000 kva Nia. Aitkarel, 3/13800/4160Y/2400
3—1500 kva, Wagner, single ph. 60 cy. 8500—2400/4160Y
3—1000 kva Westinghouse, 1/22900/480
3—1000 kva Westinghouse, 1/13800/480
1—1000 kva Westinghouse, 1/13800/2400/4160Y
3—1000 kva Standard, 1/4000/6000
3—1000 kva Standard, 1/69000/4160Y/2400
3—1000 kva Standard, 1/34400/48
3—833 Allis Chalmers 1/60/12,000-480
1—600 kva, Westinghouse, 3 phase 4800/480
3—333 kva G.E., 25 cy, 2400/4800—240/480
3—333 kva, Westinghouse, 2400/4800, 240 x 480
3—200 kva Westinghouse, 4800—240x480
3—100 kva G.E., 2400/4160Y—120x240
3— 75 kva G.E., 2400/4160Y—120x240
3— 50 kva WEST CSP, 4160/7200Y, 120/240

ERIE ELECTRIC CO., INC.
28 Mechanic St. Buffalo 2, N. Y.

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FOR SALE

1500 KW, 80% Power Factor, 3 phase, 60 cycle, 2300 volts, 3600 RPM, General Electric noncondensing steam turbine generator unit, 375 PSIG, 700° FTT, 125# exhaust back pressure, complete with direct connected shaft exciter and switchgear. Excellent condition—available immediate delivery.

EUCLID ENGINEERING CORPORATION
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Cleveland 14, Ohio

Circle 522 Reader Service Card

FOR SALE

5 KV switchgear consisting of:

2—G.E. generator panels—Type FK-225—1200 amps
2—Whse. generator panels—Type F100—1200 amps
1—Whse. generator panel—Type F100—600 amps
10—Whse. feeder panels—Type F100—600 amps
2—Whse. Auxiliary units—
All units rated 100 MVA IC, 2300 volts, 60 cycles Bus rated 2000 amps, 2400 volts.

UNION BAG — CAMP PAPER CORP.
PURCHASING DEPT. — CAMP DIVISION
Franklin, Virginia
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HI-PRESSURE
Complete Stock from 10-2,000 h.p.
Nation's largest inventory, New & Used
WABASH POWER EQUIPMENT CO.
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Circle 526 Reader Service Card

COMPLETE MODERN 400 LB. POWER PLANT

3750 KVA Elliott Turbine Generator—563 H.P. Wickes Boiler 475 PSIG W.P.

Turbine is 440 PSIG 750° FTT Generator is 3/60/2400/4160. Surface Condenser and all auxiliaries.

This plant is complete in all respects and can be inspected as originally installed. Photographs, prints and specifications available

Other turbine Generators

1-1500 KW Westinghouse	600# 750° Non-Cond. 150# BP 2400V
1-2000 KW GE	600# 750° Non-Cond. 150# BP 4160V/6600V
2-3000 KW GE	600# 750° Non-Cond. 150# BP 2400/4160V
1-2500 KW Allis Chalmers	400# Autext 150° Non-Cond. 30# 480V
1-2500 KW Westinghouse	125# Non-Cond. 10# BP 2300V
1-2500 KW GE	400# 750° Autext 25# Condensing 600V
1-5000 KW GE	600# 750 Condensing 2300/4160

Cable Address: CHASWEAVER

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DETROIT 35, MICHIGAN

Telephone: BRoadway 3-1900

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1250 K. W. TURBO GENERATORS

NEW—UNUSED

Mfg. by Westinghouse

GENERATOR:

1250 K.W.—480 volts—3 phase—60 cycle—80% P.F.—1200 R.P.M. with 18 K.W. on a 120 volt D.C. exciter.

TURBINE

540 lbs. per sq. inch gauge with 825° T.T. and one lb. per sq. inch absolute exhaust pressure. It will develop rated capacity with steam conditions of 432 lbs. per sq. inch—825° T.T. and one lb. per sq. inch exhaust pressure. Turbine R.P.M. 6050. The turbine exhausts into an auxiliary condenser.

DIMENSIONS

16'4 5/16" long—60" wide

These units originally built for Battleship Kentucky to highest Naval standards using only prime materials.

THE BOSTON METALS CO.
313 E. Baltimore St., Baltimore 2, Md.
ELIGIN 5-5050 — LEXINGTON 9-1900

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DIESEL ENGINE PARTS
for Fairbanks-Morse model 33F16 and 37F16
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PRICED TO SELL

MODERN BOILER PLANT—UTILITY SYSTEM

5—BABCOCK & WILCOX 70,000#/HR. BOILERS, INTEGRAL FURNACE TYPE FL, 750°F SUPERHEAT, 600# PRESSURE COMPLETE WITH STACKS, BLOWERS, DRIVES AND INSTRUMENTS. (NEW 1953)

1—Babcock & Wilcox 80,000#/hr. Boiler, type marine forced drafts, 750°F superheat, 600# pressure complete with stack, blower and instruments. (New 1946)
1—Grover Water Softening Plant with 8' x 30' feed water deaerator.
1—Grover Water Treating Plant with 47' x 16' water reactivator.
1—Carrier Centrifugal Blower, 3 stage, 38,300 cfm, disch. press. 32.7#, driven by 3370 HP turbine
1—Carrier Centrifugal Compresser, 6 stage, 9370 cfm, disch. press. 124.7#, driven by 2310 HP turbine
1—Carrier Centrifugal Compressor, 3 stage, 5535 cfm, disch. press. 93#, driven by 1410 HP turbine
6—Byron Jackson Cent. Pumps type 28KXL, 7000 gpm at 120' head, driven by 290 HP turbine.
1—Dean Hill Cent. Pump type 12-MC, 4500 gpm at 116' head, driven by 170 HP turbine.
1—Worthington Cent. Pump type 10-CLOS, 2750 gpm at 100' head, driven by 125 HP turbine.
2—Allis Chalmers Cent. Pumps type SH8X8, 2250 gpm at 165' head, driven by 125 HP turbine.
1—Ingersoll Rand Cent. Pump type NFV, 1510 gpm at 89' head, driven by 30 HP motor.
1—Ingersoll Rand Cent. Pump type SUV, 1200 gpm at 300' head, driven by 125 HP motor.
1—Pacific Cent. Pump type 6X5VA2TB, 1200 gpm at 290' head, driven by 120 HP turbine.
1—Lummus Surface Condenser, 6100 sq. ft., 2000—¾" x 16 ga. x 16' Admiralty tubes, 3 pass, 50#.
1—Lummus Surface Condenser, 2250 sq. ft., 728—¾" x 16 ga. x 16' Admiralty tubes, 2 pass, 50#.

COMPLETE LIST AVAILABLE ON REQUEST
REPRESENTATIVE ON PREMISES

BRILL EQUIPMENT COMPANY

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Home Office: 35-51 Jabez St., Newark 5, N. J., Tel: Market 3-7420

Circle 530 Reader Service Card

37 Years Dependable Service

SLIP RING MOTORS 3 Ph., 60 Cy.

H.P.	Volts	Make	Speed
500	4000/2300	G.E.	600
450	4000/2300	G.E.	1200
400	4000/2300	Whse.	720
300	4000/2300	G.E.	720
300	2300	G.E.	900
300	440	G.E. (hoist)	600
300	440	Whse.	3600
225	4000/2300	G.E. (hoist)	600
200	2300	G.E.	600
200	2300/440	G.E.	720
150	220/440	Whse.	720
125	2300	G.E.	600

AC GENERATORS or SYN MOTORS, 60 Cy.

H.P.	Volts	Make	Type	R.P.M.
400	2300	G.E.	TS	1800
400	2300/440	G.E.	ATI	720
300	440/220	G.E.	TS	450
300	2300/440	G.E.	TS	1200
200	440	G.E.	TS	600
150	440/220	Whse.	G	1200
125	440/220	Whse.	HR	600

SQUIRREL CAGE MOTORS

500	2300/4000	Elliott	SC	1800
400	2300	G.E.	FT	3600
400	2300/4000	G.E.	K	1200
350	2300/4000	G.E.	SEDP	3600
350	2300/4000	G.E.	K	600
300(2)	2300	G.E.	FT	3600
300	2300/4000	L. Allis.	FS	1800
300	2300/440	G.E.	SEDP	1200
300	2300/4000	Cont'l.	Spl.-Prf.	720
300	2300/400	G.E.	KT	600
250	2300/4000	G.E.	K	720
200	2300	G.E.	KT	1800
200	2300	Cont.	TEFC	3600
150	440	Whse.	X-pf.	3600
150	440/220	Cont'l.	X-pf.	1800
150	440/220	G.E.	TEFC	720
150	2300/440		KT	600
150	2300/440	G.E.	TEFC	3600
125	2300/440	G.E.	FT	1200
100(2)	4000/2300	L. Allis.	K	600
100	2300	Cont'l.	OX	1800
60(2)	440	Cont'l.	X-pf.	1800

CIRCUIT BREAKERS, 3 Pole

4—1600 Amp., DA-50, Whse., 600 V., Air
1—600 Amp., Al. Chal., 15 KV, Outdoor
6— 600 Amp., R. Smith, 7.5 KV, Sol. oper.
1— 400 Amp., R. Smith, 7.5 KV, outdoor, New

D. C. MOTORS

H.P.	Volts	Make	Type	Speed
150	230	El. Dyn.	B/brg.	800
60/75	230	G.E. (new)	CD	800/1500
50	230	G.E.	CD	1750
50	230	G.E.(4)	CD	1150

MOTOR GENERATOR SETS

		Input—	Motor	Output V.,
KW	Make	AC	Type	DC
200	Whse.	4150/600	Syn.	250/125
150	G.E.	440/220	Syn.	250
125	G.E.	440/220	Sq. Ca.	125
100	G.E.	2300/440	Syn.	230
75	Cr. Wh.	440/220	Sq. Ca.	240/120
70	El. Dyn.	440	Sq. Ca.	70
65	G. E. B	2300/440	Sq. Ca.	250

TRANSFORMERS 60 Cy.

1—500 kva, Al Ch. 2400/4160Y—600 volts, 3 ph.
3—500 kva, G.E., 12500—240/480 V.
3—200 kva, Mol., 13,800—2300 V.
3—333 kva, G.E., 13,800—2400 V.
3—333 kva, G.E., 2400—240/120 V.
3—200 kva, G.E., 13,800—480 V.
3—200 kva, G.E. 4156—480/240 V.
3—167 kva, Whse., 4156—480 V.
3—150 kva, Al. Ch., 2400—220 V.
3—150 kva, G.E., 13,200—2300 V.
3—100 kva, Whse., 4800/2400-240/480 V., Dry
3—100 kva, G.E. 2400—120/240 V., Pzr.

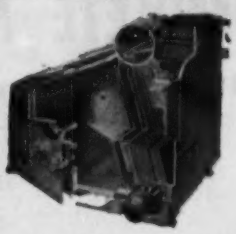
GASOLINE—ENGINE GENERATOR SETS

3—37½ kva, 1800 R, 220 V 3/60, Cont'l., 6 cyl.
only partial listing

STEPHEN **HALL** & CO.
HARRY J. RICE, Pres.
625 ADAMS ST., HOBOKEN 2, N. J.

Circle 531 Reader Service Card

BOILERS NEW UNASSEMBLED



# Steam/hr.	Key	PSI	Temp.
122,500	DF	565	850
121,650	DF	565	850
60,000	SF	435	750
74,000	H	280	500
55,000	A	240	—

DF Double Furnace, SF Single Furnace (illustrated), bent water tube boilers w/economizers and superheaters, B & W's and
A Foster Wheelers.
Header type, straight tube, B & W.
H 3 drum, single furnace, Wickes.

Pelnik-Loconti Industrial Supply, Inc.
315 Oriskany St., Yorkville, N.Y.
Utica, N. Y. Ph. RE 6-4621, RE 2-4513

Circle 534 Reader Service Card

TRANSFORMERS—60 CYCLE

Qu	KVA	Make	Type	Phase	Voltages
2	3000	Moloney	TCR	3	7200/9600-4160/2400
2	750	G.E.	K	1	4600-120/240
1	300	Penna.	(Askarel)	3	13470Y/7200-240
2	250	G.E.	H Pyranol	1	4800/2820Y/120/240
3	250	West.		1	2300/4600-230/460
3	200	G.E.	HSW2F	1	2400/4160-240/480
3	240	Amer.	CC	1	4160/7200-240/480
3	75	G.E.	KF	1	2400/4160-120/240
3	50	G.E.	H	1	2400/4160-240/120
1	50	Amer.	Abetol	3	4160-120/208Y
4	25	West.	Hypersil	1	2400/4160-120/240

MOTOR GENERATOR SETS

Qu	KW	Make	Speed	DC	AC
1	75	EM	1200	250	Syn. 220V.
1	75	G.E.	1200	125	2300/4160 Syn.
1	100	West.	1200	250	2300/4160Y Syn.
1	175	West.	1200	125	4150 Syn.
1	300	G.E.	1200	250	2300/4160Y SR
1	300	G.E.	1200	250	440 Syn.
1	300	Al-Ch.	1200	125/250	Syn. 440V.
1	1000	West.	720	600	2300/4160Y

ENGINE GENERATOR SETS

1—Hercules Gas HXE 63.5 KVA Weights 2/60/480 —1200
1—Wisconsin Gas (Air) PE-90 7.5 KVA Master 1 or 3/120—3200 r.p.m.

SLIP RING MOTORS

Qu	HP	Make	Speed	Type	Volts
2	40	West.	600	CW	220/440
1	60	G.E.	1800	MT	220
1	60	G.E.	600	MT548	440
1	75	G.E.	600	DC	440
1	100	West.	1800	T.E.F.C. B.B.	220
2	150	Allis-Ch.	1200	AY-RW	2300
1	200	West.	514	CW	440
1	250	West.	600	CW	440
1	320	West.	1800	CW	2300
1	450	West.	1150	CW-4-30-9, 220 or 440
1	500	G.E.	450	MT	2300
1	500	G.E.	1200	M500Z 2300/4160Y

D. C. MOTORS—230 VOLTS

Qu	HP	Make	Speed	Type
1	350	G.E.	1200	Pedestal
1	92	West.	425/1000	SK 173
1	30	G.E.	1750	173 FR
1	50	West.	800/1400	SK-601543

SQUIRREL CAGE MOTORS, 3 PHASE, 60 CYC.

1—300 HP, 1200, Allis. Chalmers, 2300/4160Y
1—275 HP, 1120 RPM G.E. Type KT 5503S 2300V
2—200 HP, 1780 RPM, G.E. Elec. KF, TEFC, 2300V
1—100 HP, 1775 RPM G.E. KTP-543 3 ph 60-440V.

MOTORS—SYNCHRONOUS—3 ph. 60 cy.

100 HP 900 RPM G.E. Form BL 2200 V.
125 HP 600 RPM G.E. Type TS 2300 V.
125 HP 900 RPM G.E. Type TS 4800 V.
150 HP 3600 RPM G.E. type TS Ft. 9567Y 2300 V.
150 HP 1800 RPM G.E. Type TS 220 V.
300 HP 720 RPM Elec. Machinery L.a.f.a. 2300 V.
325 HP 900 RPM West—2300 V.
400 HP 450 RPM Westinghouse Type HR 440 V.

FOR POWER
J. L. HEMPHILL & CO.
1603 54th STREET, NORTH BERGEN, N. J.

Circle 532 Reader Service Card

PRICED RIGHT
BOILERS

3—1296 HP B&W Sect. Steel Header 275 PSI Gas/Oil Fired
2—200 HP 160 PSI Keeler, Stoker Fired
12—NEW UNASSEMBLED B&W, F.W. C.E. with Superheater, Economizer, Soot Blowers, Oil Burners, Steel Encased—Rated:
122,500#/hr, 565 PSI, 850°F
44,500#/hr, 450 PSI, 735°F
35,000#/hr, 285 PSI, 577°F

A. C. MOTORS — 3 ph. 60 Cy.

Qu.	HP	Make	Type	Speed	Volt
1	2000	A.C.	ANW	1750	2300
1	350	A.C.	AZZ TEFC X.P.	3600	2300
1	250	Cont.	NP TEFC X.P.	720	2300
1	200	G.E.	KF TEFC X.P.	3600	2300
1	125	G.E.	KF TEFC X.P.	1800	2300
3	100	G.E.	K TEFC X.P.	1800	440
1	150	West.	CW Slip Ring	1800	440
3	75	West.	CW Slip Ring	1800	440
3	30	West.	CW Slip Ring	1200	440

GENERATOR SETS

11—1250 KVA Natural Gas Engine Sets 3/60/2400/4160 with switch gear *(can be seen running)*
1—500 KW Condensing 200 PSI Turbine
1—500 KW G.E. Non Condensing 265 PSI, 0-10# BP Turbo Generator

TRANSFORMERS

1—6000 KVA 3/60/44,000—4160 Substation
3— 333 KVA 1/60/2400/4160 Y—480

CRANES

40/10 ton OET 47'3" Span 75' Lift AC
25 ton Powerhouse 36'6" Span AC

HEAT & POWER CO. INC.
POWER EQUIP. DIV.

60 East 42nd St., New York 17, N. Y.
310 Thompson Bldg., Tulsa 3, Okla.

Circle 533 Reader Service Card

NEW SURFACE CONDENSERS

Size Sq Ft.	Make	Tubes	Passes
400	Allis-Chalmers	⅝"	Admiralty 2
436	C. H. Wheeler	⅝"	Cup. Nick. 2
580	Foster-Wheeler	⅝"	Cup. Nick. 2
725	C. H. Wheeler	⅝"	Cup. Nick. 2
1050	N.Y. Shipbuilding	⅝"	Cup. Nick. 2
1350	Alco Products	⅝"	Cup. Nick. 2
2000	N.Y. Shipbuilding	⅝"	Cup. Nick. 2
2200	Alco Products	⅝"	Cup. Nick. 2
3500	N.Y. Shipbuilding	⅝"	Cup. Nick. 2
11000	N.Y. Post.-Wheeler	⅝"	Admiralty 2

EASTERN SCRAP & SALVAGE CORP.
65 Muirhead Ave., Trenton 7, N. J.
OWen 5-6351

Circle 535 Reader Service Card

MODERN BOILERS

2—50,000# per hour C-E boilers, 250 psi, coal and oil fired. Units are complete with water walls, forced and induced draft fans, all valves, soot blowers, Republic controls and auxiliary equipment.

1—110,000#'s per hour C-E boiler, 675 design pressure, saturated temperature but provision for superheater, coal and oil fired, water walls, airheater, all valves, soot blowers, forced and induced draft fans. Bailey controls.

WANTED

1—CHAIN GRATE STOKER
14' wide x 10' long capable of producing 60,000# steam per hour.

MIDWEST BOILER & TURBINE CO.
Warner, New Hampshire

Circle 537 Reader Circle Card

POWER EQUIPMENT

6000 KW, G.E. Cond. Turbo-Generator 3/60, 2400 V, 3600 RPM, 200 PSI

5000 KW, West. N.C. Turbo-Generator 3/60, 2400 V, 3600 RPM, 850 PSI, 850°—150# B.P.

1000 KW, Worth.-Moore, Cond. Ext. Turbine, 3/60, 245/490V, 3600 RPM, 130-300# I.P., 10# Ext.

500 KW, West. Cond. Turbo-Generator 480V, 3600 RPM, 200 PSI, 15-30# Ext.

640 HP, B & W, Water Tube Boilers (4) 200# Sectional Header

1500 KW, West. Motor Generator Sets (2) 3/60, 2300/4600 Volts A.C.—250 Volts D.C., 514 RPM

BREW, WOLTMAN & CO., INC.
50 Church Street, New York 7, N. Y.

Circle 538 Reader Service Card

COMPLETE BOILER AND TURBINE PLANTS:

We are dismantling a boiler house, turbine plants and twelve generating water wheels. Consisting of 100,000 HP boiler, twelve 305 HP. Pumps up to 150 HP 1,200, 2,200 V, 150 HP 900, Twelve water wheels, 300 to 1,000 KV. GE curtis steam turbine generator 3,750 and 2,000 KV, 2,200 V, 1,800 and 3600 feed. GE motor gen. exciters. 150 HP 1,200, 2,200 V, 150 HP 900, 2,200 V. All this equipment must be sold this year.

COREY BUILDING WRECKING
1500 Middlesex Street
Lowell, Massachusetts
Phone: GL. 2-8909

Circle 539 Reader Service Card

BABCOCK & WILCOX COAL PULVERIZERS

2—NEW UNUSED Babcock & Wilcox coal pulverizers, Type E-56, capacity 43,600# coal per hour, each equipped with American Blower Corporation air fan, 15,000 cfm capacity with motor drive.

These are complete coal pulverizer installations with blower air fans, attached and unattached structural parts. Exceptional bargain.

UTILITIES MACHINERY CORPORATION
1965 East Sixth Street, Cleveland 14, O.

Circle 540 Reader Service Card

FOR SALE!!
"As Is — Where Is"

ONE—1450 K.W. 3-Phase, 60 cycle, 2300 volt Steam Power Plant. Complete with boilers and auxiliaries, turbo-generators, condensers, switchboard, spray pond equipment, etc. Will sell as a whole, or in part.

If interested, wire or write for detail description.

TIP H. ALLEN
General Superintendent
Canton Municipal Utilities
Canton, Mississippi

Circle 541 Reader Service Card

ELECTRICAL POWER EQUIPMENT

A. C. MOTORS—3 ph. 60 Cy.

SLIP RING

Qu.	HP	Make	Type	Volts	Speed
1	1750	G.E.	M-5798g	4800/8400	1200
1	1500	G.E.	MT-6	6600	1197
1	800	Whse.	CW	550	1775
1	600	Whse.	CW-432D-15	440	1775
1	500	Whse.	CW	550	350
1	300	G.E.	MTP-501	2300	1800
1	250	G.E.	MT-434T	4000	257
1	250	Cr. Wh.	SIEB-390	220	1450
1	250	A.C.		550	600
1	200	G.E.	IM	2300	880
1	200	G.E.	IM	2200	435
2	200	Whse.	CW-800	2300	1775

SQUIRREL CAGE

2	850	Whse.	CR-1115	2300	900
1	560	G.E.	FT-500AY	2300	3450
4	500	Whse	CR-1316	2300	860
3	500	G.E.	KF	2300	3450
2	450	Hillott	2016BB	2300	1200
2	400	Whse.	CR	4000/4000	3565
1	300	Whse.	CR-1002	2300	600
1	300	Whse.	CR-903H	2300	1175/975
1	200	G.E.	KT-557	440	1800
2	200	Whse.	CR-8455	220/440	1750
1	200	Whse.	TEFC C8873C	440	3600

SYNCHRONOUS

1	7000	G.E.	ATI	2240/6600	900
1	3500	G.E.	TS-6488P	2300/4000	300
2	1750	G.E.	ATI	2300	3000
1	1750	G.E.	TS	2300	900

M-G SETS—3 PH. 60 CY.

Qu.	K.W.	Make	RPM	DC Volts	AC Volts
2	2100/1750	G.E.	514	250/250	2300/4600
1	2000	G.E.	514	600	2300/4000
1	1500	G.E.	720	600	6600/12500
1	1500	G.E.	514	250	6600/12500
1	1500	G.E.	900	600	2300/4150
1	1200	West.	720	600	2300/4100
1	1000	G.E.	900	260	6600
1	800	G.E.	900	250	2300/4000
1	600	G.E.	900	125/250	440
1	350	G.E.	900	125	440/4160
2	300	G.E.	1200	250	2300
1	300	Whse.	1200	600	2300
1	250	G.E.	900	250	220/440
1	240	West.	900	125	220/440
1	200	Mt. Mby.	1200	250	2300/4000

TURBO GENERATORS

Qu.	KW	Make	Desc.
1	1000	G.E.	150# no Cond 2400 V.
1	6000	G.E.	400# surface condenser 2400/4150 volts.

TRANSFORMERS

Qu.	KVA	Make	Type	PH.	Voltages
2	3333	Whse.	OISC	1	13800x2300
3	1000	G.E.	OISC	1	13800x480
2	750	G.E.	PYR.	1	66/265
2	660	Kuhl.	OISC	1	13200x2000
3	500	Mot....	OISC	1	6000/11430Tx480

FREQUENCY CHANGER SETS

Qu.	KW	Make	Freq.	Voltage
1	6000	G.E.	60/50/60	11000/6600
2	3500	G.E.	25 cy/83.5	2300/3800

RE-NU-BILT BY

BELYEA COMPANY, INC.
43 Howell St., Jersey City 6, N. J.
Tel: OLDFIELD 3-3334

Circle 542 Reader Service Card

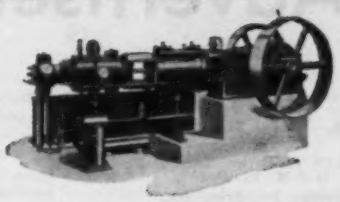
DIESEL ENGINE PARTS
for Fairbanks-Morse model 38-D
BEARINGS • 10 SETS ONLY!
Main bearing 817
Connecting rod bearings 19A

A. G. SCHOONMAKER Company, Inc.

Foot of Spring St., Sausalito, Calif.
EDgewater 2-1490
50 Church St., New York 7, N. Y. Digby 9-4351

Circle 543 Reader Service Card

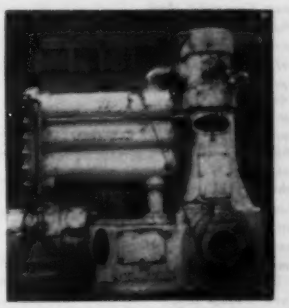
THE COMPRESSOR LINE



Three-Stage Compressor.

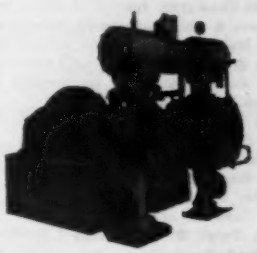
HIGH PRESSURES

87 CFM 1500 psi 8½—8½—1⅝ x 7 CP TCB 3
104 CFM 2500 psi 6¾—4½—1-11/16x9 IR ES3
311 CFM 1500 psi 10½—7⅞—3⅛ x 13 IR ES3



595 c.f.m. 125 PSI Sullivan WJ3 Angle compound MVD 100 H.P. motor 3-60-220/440 Excellent Unit—In our plant.

PENNSYLVANIA Single Stage Duplex Synchronous Motor Driven Air Compressor. 2500 CFM 50 PSI—300 H.P. This compressor used only (6) months by large oil refinery. 19—10x14 Pennsylvania DEI Duplex-single stage with 300 H.P. Elec. Mach. Syn. Motor 3-60-2300 I PF. Can be seen on original foundation, Baltimore, Md.



1085 CFM Displacement 60-110# 277 RPM. 18—11x12 Ingersoll-Rand XRE, two stage, double acting, duplex, water-cooled, heavy duty, horizontal, synchronous motor driven air compressor equipped with: Step control; Mechanical force feed cylinder lubrication; Automatic frame oiling system; Intercooler with safety valve & pressure gauge, DIRECT CONNECTED TO: 175 HP General Electric 277 RPM unity power factor 3/60/440 volt engine type synchronous motor complete with starter and exciter.

(CAN BE SEEN RUNNING)

**For any size or make compressor try American Air.*

AMERICAN AIR COMPRESSOR CORPORATION

Dell Ave. & 47th St. North Bergen, N. J.
UNion 5-4848

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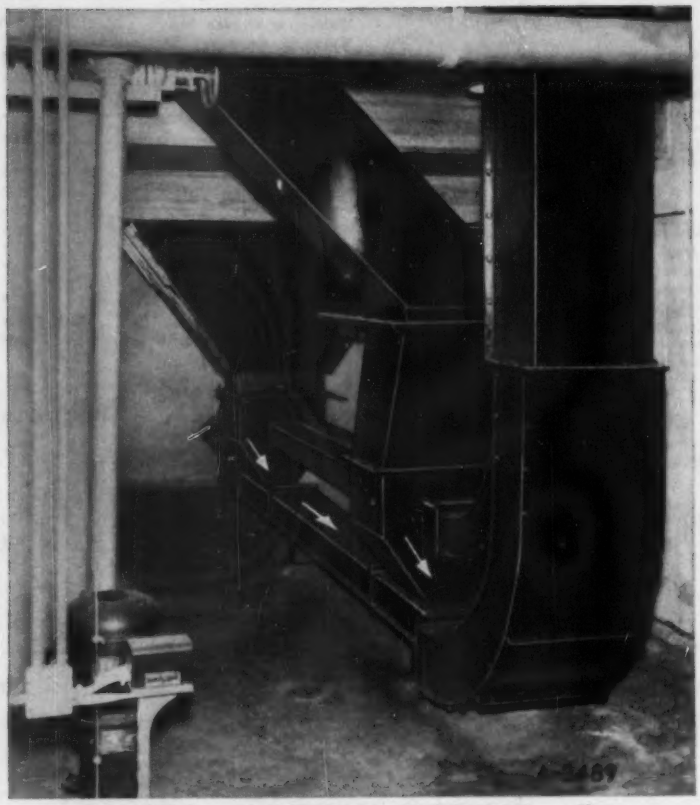
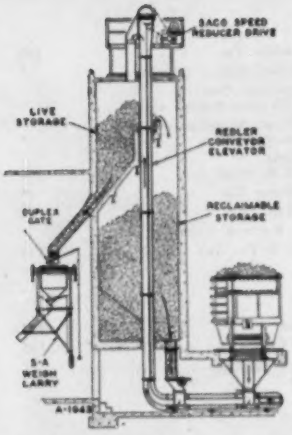
STEPHENS-ADAMSON



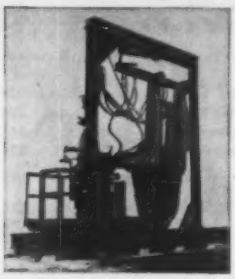
L-type REDLER Conveyor-Elevator System in Midwestern Power Plant



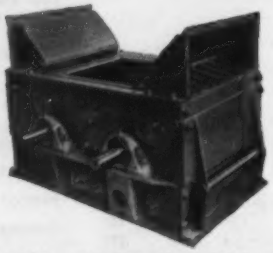
Drawing above illustrates flow of coal through a typical REDLER Conveyor-Elevator installation.

Vertical Closed-Circuit REDLER Elevator discharges coal into double-roll Knittel Sampling Crusher. Coal "cut" from main flow is sampled for B.T.U. content.

REDLER® Conveyor-Elevator INCREASES EFFICIENCY ...LOWERS COST IN COAL HANDLING!



S-A HYDRAULICALLY POWERED CARQUAKE — Maximum efficiency in unloading hopper cars without objectionable noise. One man controls operation. No expensive overhead structures — a completely self-contained unit. 2 types available.



S-A RING TYPE DOUBLE ROTOR KNITTEL CRUSHER — Crushes lumps while in suspension . . . no breaker plates needed. Maintains full capacity with wet coal — no clogging. Greater capacity—less space required.

STEPHENS-ADAMSON engineered REDLER Conveyor-Elevator Systems backed by over a half century of coal handling "Know-how" provide dependable coal handling service at the lowest cost-per-ton figured over the life of the equipment. In the Midwestern installation shown above, an L-type REDLER Conveyor-Elevator System handles distribution from an unloading hopper to a storage silo and from reclaimable storage to live storage shelf or direct to boiler room. Dust is confined within the sealed REDLER casings thereby contributing to good housekeeping. S-A REDLER coal handling systems save space, offer flexibility in application and often combine both conveying and elevating operations usually with only one drive.

REDLER Conveyor-Elevators are available in sizes to handle practically any tonnage. They can be designed to fit into any new or existing structure and will occupy a minimum of space.

WRITE FOR BULLETINS 358, 858 and 658

S-A
ENGINEERED BULK HANDLING SYSTEMS
SPEEDWALK® PASSENGER CONVEYORS
SPHERICO® BEARINGS & ROD ENDS

ENGINEERING DIVISION
STEPHENS-ADAMSON MFG. CO.
GENERAL OFFICE & MAIN PLANT, 5 RIDGEWAY AVENUE, AURORA, ILLINOIS

PLANTS LOCATED IN: LOS ANGELES, CALIFORNIA • CLARKSDALE, MISSISSIPPI
BELLEVILLE, ONTARIO

For more facts circle 343 on Reader Service card, p 117

DOW | **SARAN LINED PIPE**

After more than 3 billion pounds of acid and alkali solutions
No replacement of corrosion-resistant Saran Lined Pipe

When utility power plant piping must carry six million pounds a day of acid-and-caustic-treated water . . . piping in which a single failure would shut down the entire water-treatment system . . . dependable corrosion resistance becomes a matter of public safety.

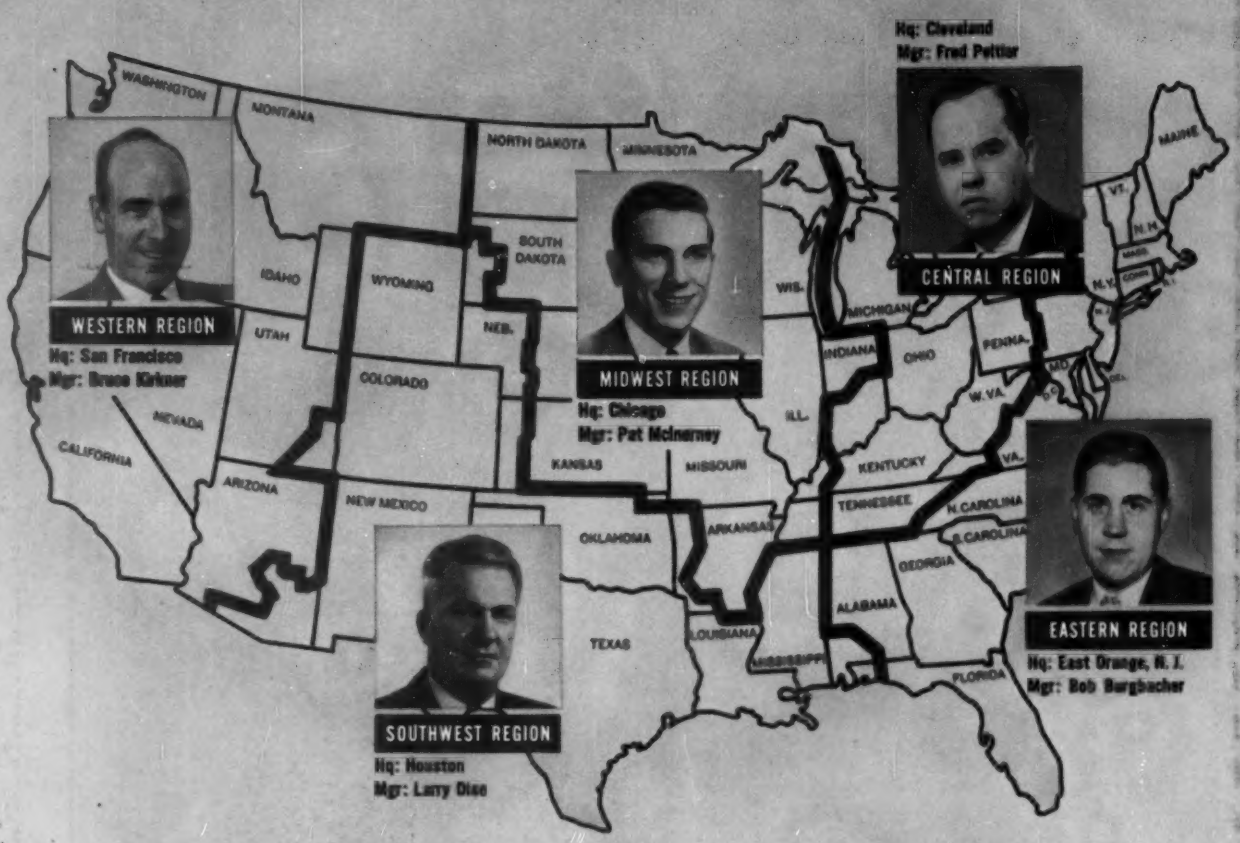
Wisconsin Electric Power Company's Commerce Street power plant in Milwaukee furnishes steam for heating a 24 square-block area in downtown Milwaukee. In this plant Saran Lined Pipe is used to carry acid-treated and caustic-treated city water to cation and anion tanks for demineralization prior to use in the plant's high-pressure steam system. Approximately 725,000 gallons a day of the corrosive liquids pass through the system, one section of which is shown above.

Saran Lined Pipe was first installed in this power plant 2½ years ago. Since that time, despite a total volume flow of over *THREE BILLION* pounds, there's never been a replacement of the Saran Lined Pipe. Mr. Fred H. Long, Chief Chemist of Power Plants for the company, stated that an additional advantage of Saran Lined Pipe is ". . . we find that the pipe is relatively easy to cut to proper length. We don't have to order exact pre-cut lengths, then wait for delivery. This also . . . looks like the best type of pipe we've tried for resistance to corrosion and ease of maintenance."

Whenever piping systems *must* resist corrosion and chemical activity, no matter how extreme the conditions, it'll pay to specify dependable Saran Lined Pipe. Saran Lined Pipe, fittings, valves and pumps are available for systems operating from vacuum to 300 psi, from below zero to 200° F. They can be cut, fitted and modified easily in the field without special equipment. For more information, write Saran Lined Pipe Company, 2415 Burdette Avenue, Ferndale, Michigan, Dept. 2288DW2.

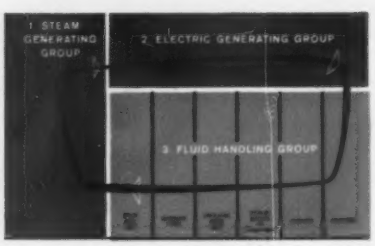
THE DOW CHEMICAL COMPANY • MIDLAND, MICHIGAN

For more facts circle 202 on Reader Service card, p 117



Regional Engineering and Service:

DECENTRALIZED TO SERVE YOU BETTER



Look at all three. A power plant consists of three major functions: steam generating, electric generating, and fluid handling. As the manufacturer of all major components of the *fluid handling group,* (pumps, deaerators, condensers, ejectors) Worthington has a reservoir of experience and knowledge that can benefit you.

Fast, expert service for utility customers everywhere: that's the goal of Worthington's unique Regional Engineering and Service plan.

Besides a headquarters operation, the R.E.&S. plan provides for five separate regional organizations. R.E.&S. men are located close at hand, ready to go to work at a moment's notice. They provide engineering advice and assistance on operational problems. They'll make periodic inspections of Worthington equipment in your plant and instruct personnel in proper operation and maintenance. All this in addition to trouble-shooting Worthington equipment on the rare occasions when it is necessary.

Not an exciting subject—service—but an important one. And Worthington works as hard at providing the best in service as well as the best in research, design, engineering, and manufacture of all its fluid handling products. Worthington Corporation, Harrison, N. J. In Canada: Worthington (Canada) Ltd., Brantford, Ont. 45-10

WORTHINGTON

For more facts circle 203 on Reader Service card, p 117